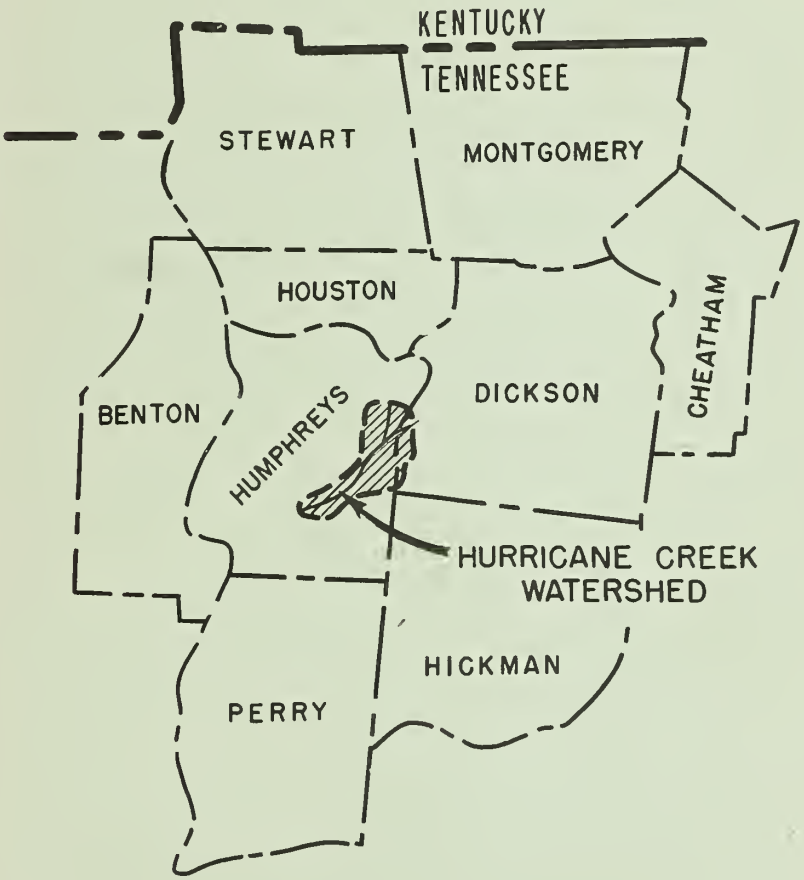
WATERSHED WORK PLAN

HURRICANE CREEK WATERSHED

HUMPHREYS AND DICKSON COUNTIES, TENNESSEE



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND
FOREST SERVICE

4-24772 12-70
USDA-SCS-FORT WORTH, TEX. 1970

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WATERSHED WORK PLAN AGREEMENT
between the
Humphreys County Soil Conservation District
Dickson County Soil Conservation District
Humphreys County
City of McEwen
(hereinafter referred to as the Sponsoring Local Organization)
State of Tennessee
and the
Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Hurricane Creek Watershed, State of Tennessee, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Hurricane Creek Watershed, State of Tennessee, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost $113,500).

2. The Sponsoring Local Organization will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and

the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State Law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

The Service will bear 100 percent of the first $25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of $25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the sponsoring local organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	20.8	79.2	0

Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business or farm operation. However, if relocation becomes necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures and Mitigating Measures	0.0	100.0	1,213,300
Mutliple-Purpose Structure No. 3A	25.0	75.0	142,800
Water Outlet Structure	100.0	0.0	12,600

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Cost (dollars)
Floodwater Retarding Structures	0.0	100.0	172,900
Multiple-Purpose Structure No. 3A	25.0	75.0	39,200
Water Outlet Structure	100.0	0.0	2,400

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be $19,700 and $115,900, respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial working arrangements and other conditions that are applicable in the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

HUMPHREYS COUNTY

By _____

Title _____

Address _____
(Zip Code)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of Humphreys County adopted at a meeting held on _____ _____.

_____
(Secretary, Humphreys County)

Address _____
(Zip Code)

Date _____

HUMPHREYS COUNTY SOIL CONSERVATION DISTRICT

By _____

Title _____

Address _____
(Zip Code)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Humphreys County Soil Conservation District adopted at a meeting held on _____.

_____
(Secretary, Humphreys County Soil Conservation District)

Address _____
(Zip Code)

Date _____

DICKSON COUNTY SOIL CONSERVATION DISTRICT

By _____

Title _____

Address _____
(Zip Code)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Dickson County Soil Conservation District adopted at a meeting held on _____.

_____
(Secretary, Dickson County Soil Conservation District)

Address _____
(Zip Code)

Date _____

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CITY OF McEWEN

By _____

Title _____

Address _____
(Zip Code)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the City of McEwen, Tennessee, adopted at a meeting held on _____.

_____
(Secretary, City of McEwen)

Address _____
(Zip Code)

Date _____

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

WATERSHED WORK PLAN

HURRICANE CREEK WATERSHED

Humphreys and Dickson Counties, Tennessee

Prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Humphreys County

Humphreys County Soil Conservation District

Dickson County Soil Conservation District

City of McEwen

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

August 1971

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WATERSHED WORK PLAN
HURRICANE CREEK WATERSHED

Humphreys and Dickson Counties, Tennessee

August 1971

SUMMARY OF PLAN

This is a plan for development of the soil and water resources in the 52,780-acre Hurricane Creek Watershed LOCATED within Humphreys and Dickson Counties in the western part of Middle Tennessee. The plan was developed by the sponsors under authority of Public Law 566, as amended, with assistance from the United States Department of Agriculture, Soil Conservation Service and Forest Service. The SPONSORS are:

Humphreys County
Humphreys County Soil Conservation District
Dickson County Soil Conservation District
City of McEwen

The primary PROBLEMS in the watershed are floodwater damage, overbank deposition of sediment, flood plain scour and associated indirect damage. Some portions of the main flood plain begin flooding following rainfall of about 2.2 inches within a 24-hour period. The largest storm in the past 20 years occurred on January 29-30, 1956, and caused flooding on 4,770 acres of land. It is estimated that 5,150 acres of bottom land is subject to flooding by a 100-year frequency storm.

The principal OBJECTIVE of the sponsors is to improve the social and economic atmosphere, not only within the watershed, but also within Humphreys and Dickson Counties. Dickson County is eligible for assistance under the Public Works and Economic Development Act of 1965. To meet this objective, they feel that the plan must: (1) accomplish a significant improvement in establishing soil and water conservation measures; (2) reduce flooding to the extent that 75 percent of the flood plain can be used more intensively for the production of crops and pasture at least two years out of three; (3) reduce to a minimum the flood damage to roads, bridges, and other fixed improvements; (4) provide the city of McEwen a source of industrial water; and (5) maintain the present fishery resources in Hurricane Creek.

The WORKS OF IMPROVEMENT to be installed during a 5-year period are: (1) needed conservation measures on 7,575 acres of land for watershed protection; (2) seven single-purpose floodwater retarding structures; (3) one multiple-purpose structure for flood prevention and storage of industrial water; and (4) modification of principal spillways of the seven floodwater retarding structures to preserve and replace fishery habitat.

The land treatment measures will be voluntarily planned and applied by the landowners in cooperation with the going and accelerated program of the soil conservation districts. Such cost-sharing assistance as will be available under the Rural Environmental Assistance Program or other going programs will be utilized in applying them. Technical assistance for

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applying and maintaining the forestry measures will be furnished by the U. S. Forest Service, by and through the Tennessee Division of Forestry. The Soil Conservation Service will use P. L. 566 funds to accelerate technical assistance needed for application of the other planned measures.

The estimated INSTALLATION COSTS of the project measures are:

Project Measures	Installation Cost (Dollars)		
	P. L. 566 Funds	Other Funds	Total Cost
(1) Conservation Land Treatment	46,300	239,900	286,200
(2) 7 Floodwater Retarding Structures Incl. Spillway Modification	1,356,800	91,500	1,448,300
(3) Multiple-Purpose Str. No. 3A & Water Intake Structure	136,500	82,500	219,000
(4) Project Administration	115,900	19,700	135,600
TOTAL PROJECT COST	1,655,500	433,600	2,089,100

Average annual BENEFITS to be derived from installation of the project structural measures are:

Flood Damage Reduction	
Crops and Pasture	$ 38,695
Other Agricultural	5,443
Non-Agricultural	
Roads and Bridges	21,726
Erosion	6,979
Sediment	4,272
Indirect	13,888
Local Secondary	13,532
Industrial Water Supply	7,500
More Intensive Land Use	37,310
TOTAL	$149,345

The average annual COST of the structural measures is $97,012 and yields a benefit-cost ratio of 1.5 to 1. Estimates also indicate that about 2,500 people utilizing industrial and farmlands in the watershed will be directly benefited. About 4,820 acres will be directly benefited.

The Sponsoring Organizations have the authority to plan and install the proposed structural measures and will be responsible for adequately PROTECTING, OPERATING, AND MAINTAINING the structural measures at an estimated average annual cost of $4,000.

FEDERAL financial and technical ASSISTANCE will be administered by the U. S. Department of Agriculture, Soil Conservation Service and Forest Service under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

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DESCRIPTION OF THE WATERSHED

Hurricane Creek Watershed has a drainage area of 52,780 acres (82.5 sq. mi.) with 50,840 acres (79.4 sq. mi.) in Humphreys County and 1,940 acres (3.1 sq. mi.) in Dickson County. The watershed is in the shape of an inverted boot. The "foot" of the "boot" has a north-south distance of about eight miles, and the "leg" of the "boot" runs in an east-west direction for a distance of about thirteen miles. The average width of the "foot" is about five miles and the "leg", four miles. Hurricane Creek is a southwesterly flowing stream and is a tributary of the Duck River. Its confluence with the Duck River is at Duck River Mile 17.1, one mile upstream from the confluence of the Duck and Buffalo Rivers and at about the easement elevation of Kentucky Lake.

Historical Data

Humphreys County was originally a part of North Carolina and was granted to survivors of the Revolutionary War. It was Indian territory until about 1805. A few hardy pioneers, enticed by the abundance of cheap land, abundant wood, water and game, braved the dangers and hardships and settled along many of the streams as early as 1800. The agriculture was of the typical pioneer type and the produce was used principally in the home. The county was formed on October 9, 1809.

The first church was built by Methodists in 1806 on the site that was later Reynoldsburg. In the 1850's, McEwen was founded by a Catholic priest, the Rev. L. Orengo. He established the Catholic Parish of McEwen. Probably, the first churches erected on Hurricane Creek were by the Cumberland Presbyterians, "at the campground near Harry Hunter's place", and Bethpage Church was near the present site of Bethpage Cemetery on Little Hurricane Creek.

Early settlers in Humphreys County were principally Anglo-Saxon. They came from Tennessee, Kentucky, Virginia, North Carolina, Alabama, Mississippi, and also from Ireland, France, and Germany. Most of the Irish settled in McEwen. Early settlers on Hurricane Creek were Benjamin Holland, William and Samuel King, David Bibb, Daniel Forsee, William May, William Lomax, Joseph Shouse, Drury Taylor, Charles Brown, and John Johnson.

The population of Humphreys County peaked at almost 14,000 in 1910. There was a steady decline in population until a major manufacturing plant located in the county in 1958. In 1960, there were still 2,500 fewer people living in the county than there were in 1910.

Industrial development was slow as corn mills, cotton gins, and stillhouses made their appearances. The first corn mill of record was built in 1810 and was operated by water power. In about 75 years, 30 of these mills had been put into operation.

In 1895, James T. Anderson moved to Hurricane Mills and built a mill dam after that year. He operated a general merchandise firm with his sons which dealt in farm implements, wagons, undertaker goods, groceries, hardware, dry goods, and many other lines.

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During this period, there were at least three industries located at Hurricane Mills. These were a carding factory which manufactured mens' jeans and trousers, a flour mill which manufactured Richmond Sifter and St. Elmo flour, and a stave mill which employed up to 50 persons and turned out 12,000 staves per day.

Today, Hurricane Mills is one of the outstanding scenic spots of the county where the beautiful ante-bellum home built by George W. Hillman on a hill overlooks Hurricane Creek. The scene is dominated by an old mill and dam that stretches across the creek.

Jesse James lived in Humphreys County for about two years in the late 1870's. He received his mail at a post office called Box Station, which was less than 10 miles from Hurricane Mills. He farmed during this time in a section of the county known as the Big Bottoms. During this period, Jesse attended an election at Hurricane Mills and passed out. When his coat was opened so that he could be revived, it was discovered that he was wearing a pistol. This was considered unusual; but since Mr. Howard, Jesse's alias, was a good farmer, no one questioned him. Some time later, Mr. Howard borrowed several hundred dollars from a local resident. When he was unable to repay the debt, he left the county and moved to Nashville.

Physical Data

The rainfall distribution during the growing season is generally adequate for crop production. At present, there are no irrigation systems nor are there any planned for this watershed. Water sources are generally adequate for water needs. Water for domestic use is supplied from drilled wells and springs and livestock water is obtained from farm ponds, springs and streams. There is no indication of a shortage in the ground water supply; however, wells yielding large quantities of water are not common in the area. The mean annual precipitation is about 50.94 inches with 29.92 inches occurring in the months of April through November. The wettest month is January with a mean of 6.06 inches and the driest month is October with a mean of 2.70 inches. The mean annual temperature is 59.7 degrees with the monthly averages of 40.2 degrees in January and 79.0 degrees in July. The average length of the growing season is 197 days with the first and last killing frosts occurring in the months of October and April, respectively.

The watershed is located in the Highland Rim physiographic province. Hurricane Creek rises in the "toe" of the "boot". In this area, the uplands, which consist of loess remnants of coastal plain material and cherty limestone residuum, are fairly broad to narrow ridgetops with steep sideslopes. The slopes range from three to twenty-five percent and the difference in elevation between ridgetops and adjacent flood plain is about 120 feet. The uplands in the remainder of the watershed are highly dissected with narrow, winding ridgetops and deep, "V"-shaped valleys. The difference in elevation between the ridgetops and adjacent flood plain in this area is about 180 feet and the maximum relief in the watershed is 480 feet which is the difference in elevation between the highest points on the eastern divide (860 feet MSL) and the confluence of Hurricane Creek with Duck River (380 feet MSL).

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The geologic formations exposed in the watershed range in age from Mississippian to Recent. The geologic column representing the stratigraphic sequence of sedimentary layers exposed or near the surface is as follows:

SYSTEM	SERIES	FORMATION
Quaternary	Recent	Alluvium
Tertiary	Pleistocene	Loess
Cretaceous	Upper Cretaceous	Tuscaloosa Formation
Carboniferous	Mississippian	St. Louis Limestone Warsaw Formation Ft. Payne Formation

The youngest geologic material is represented by the alluvium of the flood plains. This material consists of unconsolidated deposits ranging from silty clay to coarse gravel and the thickness varies from a featheredge to about 80 feet.

The Pleistocene loess which caps the ridges in this area is a windblown silt and averages two to three feet in thickness.

The Upper Cretaceous is represented by the Tuscaloosa Formation which consists of a compact, white chert gravel with well-rounded pebbles from less than one inch to about six inches in diameter. There is some sand mixed with the gravel but very little silt and clay. The maximum thickness of this formation in the watershed has not been determined, but it is at least 30 feet. This formation is exposed in the uplands in the "toe" of the "boot".

The St. Louis and Warsaw Formations of Mississippian age are the youngest consolidated rocks exposed in the watershed. These formations are composed of bluish-gray limestone with nodular and cellular chert with some sandstone and shale beds. These formations typically weather to a red, cherty clay, fossiliferous residuum which is locally as much as 100 feet thick. The total thickness of the two formations is estimated to be about 250 feet.

The Ft. Payne Formation of Mississippian age, which is the oldest formation exposed in the watershed, is composed of siliceous, calcareous shale and sandy, cherty, earthy limestone. The topmost beds are thin, cherty limestone and the lower part is predominantly a massive blue-gray limestone in this area. The weathering of this formation produces a buff-yellow, cherty clay residuum. The thickness of the Ft. Payne Formation has been estimated to be from 90 to 275 feet.

The soils developed in this watershed are divided into four general soil associations. They are the Bodine-Mountview-Brandon association, the Humphreys-Ennis-Lee association, the Pickwick-Etowah (gravelly)-Humphreys association, and the Brandon-Lax-Guin association.

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The Bodine-Mountview-Brandon association occupies about 78 percent of the watershed and is found in the uplands except in the "toe" of the "boot". Bodine soils occupy the steep lands and are cherty, porous, acid, excessively-drained, and low in fertility. The Mountview soils have developed in the thin loess mantle on the ridgetops and are well-drained, acid, and moderately low in fertility. Brandon soils occupy a similar position and have the same characteristics as the Mountview, but the underlying material is coastal plain gravel rather than angular chert.

The Humphreys-Ennis-Lee association occupies about 10 percent of the watershed and is found in the flood plain of the main stream and its tributaries. Humphreys and Ennis soils are deep, well-drained, often cherty, and moderately productive. Lee soils are deep, poorly-drained, and moderately productive. About 58 percent of the flood plain soils are in Capability Class I, 34 percent in Capability Class II, and 8 percent in Capability Class III.

The Pickwick-Etowah (gravelly)-Humphreys association occupies about five percent of the watershed and is found adjacent to the flood plains. Pickwick soils are deep, well-drained, and moderately productive. Etowah (gravelly) soils are steep, deep, well-drained, and low in productivity. The Humphreys soils have been described above; however, they are gravelly in this association.

The Brandon-Lax-Guin association occupies about seven percent of the watershed and is found in the uplands in the "toe" of the "boot". The Brandon soils have been described above and are found on gentle to sloping topography on the ridgetops. The Lax soils have developed in loess over coastal plain gravel on the ridgetops. They are moderately productive, moderately well-drained, and have a fragipan at 22 to 30 inches. Guin soils have developed in coastal plain gravel on steep slopes. These soils are porous, acid, low in fertility, and give little response to management.

The present land use distribution and the hydrologic cover conditions in the watershed are 70 percent woodland with mostly poor to very poor cover conditions, 16 percent cropland with good to poor cover conditions, 10 percent grassland with fair cover conditions, and 4 percent idle or miscellaneous use with poor to fair cover conditions.

Forest Land

The topography of the forested area is moderately sloping to steep. The forest soils, principally Bodine, generally are moderately deep and well- to excessively-drained and contain a moderate amount of chert and gravel. Upland forest land makes up over 70 percent of the watershed area; eight percent of this land has been cultivated during the past 50 years. All of the forest land is privately-owned. There are no lands administered by the U. S. Forest Service on the watershed.

Because of past burning, grazing, and logging damage, much of the forested area is in poor hydrologic condition. While overland flow from the woodland is generally low because of the high soil porosity, the poor hydrologic condition has increased storm runoff by reducing storage capacity.

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Increased soil erosion and sedimentation and reduced site productivity are other damaging effects of poor hydrologic condition. According to the watershed survey, 7 percent of the forested upland has a high potential for hydrologic improvement under good watershed management; 48 percent has a medium potential; and 45 percent has a low potential for such improvement.

The watershed lies in a region of oak-hickory forest types. Ten percent of the woodland area is made up of good hardwood sites bearing hardwood species of high value for soil building and timber production and 89 percent is made up of fair hardwood sites bearing hardwood species of moderate to average value for soil building and timber production. White oak, hickory, scarlet oak, dogwood, post oak, and yellow poplar are the predominant species.

Average merchantable stand size is size is six percent sawtimber, 33 percent poles, and 61 percent seedlings, saplings, or understocked. Total stocking is high on most of the woodland. Merchantable stocking is poor on 32 percent of the upland soils. Average merchantable volume for sawtimber is considerably less than 1,000 board-feet per acre; average merchantable cordwood volumes are less than two cords per acre. (Over 99 percent of all this material is hardwood).

Fire protection is given by the Tennessee Division of Forestry in cooperation with the U. S. Forest Service. No forest fires have occurred in the watershed during the past 5 years. Thus, present fire protection facilities are adequate for watershed purposes.

Fish and Wildlife

Directly or indirectly, Hurricane Creek is responsible for much of the hunting, particularly raccoon, and all of the fishing that now occurs. Habitat conditions over most of the length of the stream are very good. Such conditions include adequate cover for smallmouth bass and rock bass as a result of rocks, ledges, and sucken logs. Water conditions in terms of quality, temperature, and turbidity are good.

Smallmouth bass and rock bass are the most popular sport fishes in the stream, and fishing pressure is moderate to high. The mill dam at Hurricane Mills is important as a barrier to harmful carp and shad migrating from Kentucky Lake. Crappie and stripes run the lower creek in the spring and at that time afford excellent fishing. From 1954 to 1958, rainbow trout were stocked in the cool waters around Shiloh Church on a put-and-take basis. Stocking was discontined because of lack of use until 1968 when stocking of rainbow trout and brown trout was resumed. In the fall of 1962, redbreast sunfish were stocked over the length of the stream on an experimental basis, but none have been reported caught. Pond fishing in the watershed is negligible with only four of the seventy-nine ponds being over one acre in size.

The gray squirrel is the most important game species in the watershed and has the most potential for immediate increase. This is due to about 70 percent of the watershed being in timber, some of which is mast-producing and, therefore, is prime squirrel habitat. This species of game is hunted most by the local people. A close investigation showed

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timber stands tend to be too dense for best rabbit, quail, and deer habitat, and that the idle lands also provide low-quality game habitat. Dove, duck, and goose numbers are associated closely with row crops, particularly corn. The extensive corn fields in the flood plain of the watershed prove particularly attractive to dove, ducks, and geese. The wildlife conditions in the watershed are fair under the present land uses, but the potentials for all species now present would be even better with land management that would provide more food and cover.

Economic Data

The agricultural economy of the watershed is largely dependent upon the raising of livestock and the growing of cultivated crops.

Factors which have attributed to the decline of the local economy include frequent flooding of farmland in the creek bottoms, under-management of forest lands, lack of locally available risk capital, and limited opportunity for local employment.

The present land use distribution is 8,282 acres in cropland, 5,344 acres in grassland, 37,128 acres in woodland, and 2,026 acres in miscellaneous use. About 68 percent of the cropland is in or adjacent to the flood plain. The flood plain is nearly all open land and is the most fertile and productive to be found within the watershed. It is highly important to the overall agricultural economy. The average net income per farm is low because of the low natural fertility and physical characteristics of the uplands and low intensity of use of the flood plain due to flood damage.

According to the latest available County Agricultural census (1964), the average value of farm products sold per farm in Humphreys and Dickson Counties is about $2,800. The average value of farm products sold per farm in the Hurricane Creek Watershed is estimated to be close to the two-county average. The ten-year average (1954-63) value of products sold per farm in Tennessee is about $4,000. The average value of farm products sold in the Hurricane Creek Watershed is 30 percent below the state average. The forest lands produce only two percent of the gross income.

The chief source of gross income from marketing farm products is livestock, with hogs, beef cattle, dairy products and sheep ranking in descending order. The number and quality of livestock on nearly every farm increased in recent years. The principal crop grown in terms of acreage is corn. Grain and forage crops are used primarily as feed in the livestock program.

There are about 185 families, or 800 people, living on 170 farms. There are 50,000 people living within 25 miles of the watershed. Seventy-five percent of the farms are owner-operated and range in size from 50 acres to

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2,000 acres. It is estimated that the average size of the 100 farms containing flood plain is 320 acres and the value, including fixed improvements, is $46,000, with the average value of the flood plain land estimated to be about $500 per acre. The average size of the upland farms is 240 acres and the value, including fixed improvements, is $19,000. The average size farm in the watershed is about 287 acres.

The towns of Waverly, Dickson, New Johnsonville, and McEwen, Tennessee, are the chief trade centers and work areas for off-farm employment. Nashville, which is 40 miles east, is the leading market for farm products, although other markets are available in neighboring counties. It is estimated that 40 to 50 percent of the farm families supplement their farm income by off-farm employment.

The watershed is serviced by a network of Federal, state, and county roads. The eastern portion is served by U. S. Highway 70 which crosses the flood plain near McEwen and State Highway 13 serves the western portion of the watershed. A county gravel road parallels the flood plain over most of its length. Besides these, there are a number of other hardsurfaced and gravel roads that provide access to nearby markets and business areas.

The population of Humphreys County peaked in 1910 with almost 14,000 people. The population then declined until a major manufacturer located a plant in the County in 1958. The population still has not regained the 1910 level. The purchase of 35,000 acres of bottomland along the Tennessee and Duck River for impoundment of water behind the TVA Kentucky Dam has adversely affected the economy and growth of Humphreys County for more than two decades. The area acquired represented about 35 percent of the bottomland in Humphreys County which was once prime farmland that made a significant impact on the economy.

The city of McEwen is located on U. S. Highway 70 in Northeastern Humphreys County and adjacent to the northeast watershed divide. The city was founded in the early 1850's. The acquisition of bottomland and displacement of rural people due to the development of Kentucky Lake and the wildlife sanctuary administered by the Department of Interior has made a substantial contribution to the steady growth of McEwen. The population trend during the past three decades and projected growth follows:

Year	Population	Percent Increase
1940	617	-
1950	710	15
1960	979	59
1970	1,237	100
2000	2,100	240
2020	2,300	273

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The present non-farm labor force of McEwen and surrounding area is about 500 to 600 people. About one-third of the labor force is employed locally. The remainder commute from some distance up to 60 miles outside the area in search of suitable employment. It is estimated that 40 to 50 percent of the farm families in the area supplement their income by off-farm employment. The demand for jobs creates an atmosphere of unemployment or underemployment.

As stated in the Overall Economic Development Program for Humphreys County, Tennessee, on Page 19, dated January 1962, the following is the General Evaluation of the Redevelopment Area and Its Economy.

> "In short, Humphreys County has an economy which is vigorous in its industrial-urban centers, slack on its farms, and basically dormant in its forests and other resources. The industrial-urban center are not, as yet, sufficiently large to absorb the work force available, but the evidence is that this growth can be accomplished, that the potential is there, and that, when it is realized, the advantages of climate, location, and small-farm life are such that not only general prosperity will follow from this development but a unique combination of urban-industrial progress coupled with a close-to-the-soil stability and steadfastness of spirit. In these potentials, we think we have the means at hand to achieve our own industrial revolution avoiding, as we do it, many of the pitfalls that have accompanied industrial revolutions elsewhere."

The evaluation of Bases for Economic Growth, as stated in this report on page 33, is as follows:

> "Thus, overall, Humphreys County has major areas of top-ranked industrial potential area, up to 10,000 persons ready to work, agricultural land sufficient to accommodate thousands of five-and-ten-acre farms if the "farmer" can earn his living in industry, almost unlimited recreational potential, the possibilities of doing something with its hardwood and iron ore, the opportunity to improve significantly the quality of its work force, and, at last, access to the capital which can make reality of these potentials. These, we believe, make up the pattern of our opportunity for growth."

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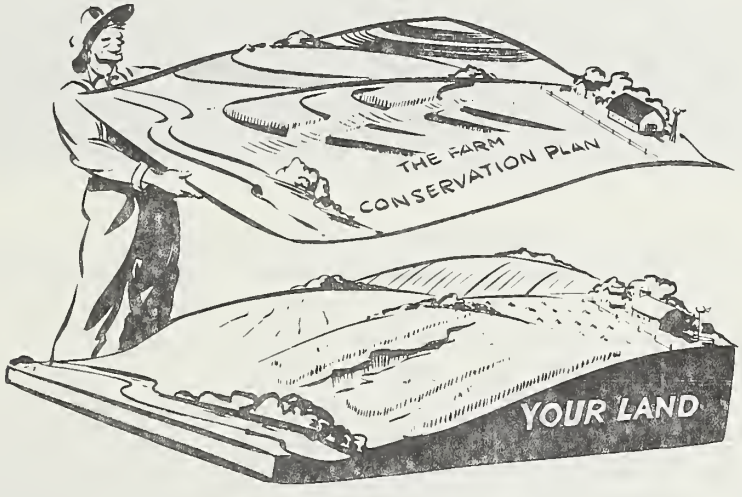
Land Treatment Data

The entire watershed is under the Soil Conservation District Program of the Dickson and Humphreys County Districts organized in 1952 and 1953, respectively. There are 34 farms containing 9,123 acres (17%) which have conservation plans. In the 10-year period from 1958-1969, conservation measures were applied in the watershed with District assistance at a total estimated cost of $372,795.

The Tennessee Division of Forestry, in cooperation with the U. S. Forest Service, provides forest fire protection and forest management assistance for private landowners in the watershed. These services are provided through Section 2 of the Clarke-McNary Act and the Cooperative Forest Management Act.



WATERSHED PROBLEMS

The primary problems in the watershed are floodwater damage, overbank deposition of sediment, flood plain scour and associated indirect damages. The total average annual flood damage under present conditions is estimated to be $111,073, Table 5. The average annual flood damage to crops and pasture values is $50,258; roads and bridges, $23,640; other agricultural, $6,671; overbank deposition of gravel, $5,568; flood plain scour, $8,994; and indirect, $15,942. The present average value of the 5,150 acres of flood plain land is about $500 per acre.

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Floodwater Damage

It is estimated that 5,150 acres of bottom land is subject to flooding by water overflowing from Hurricane Creek and its tributaries. Some portions of the main flood plain begin flooding following rainfall of about 2.2 inches within a 24-hour period. Flooding from smaller or medium storms occurs on an average of about three to four times per year. The largest storm in the past 20 years occurred January 29-30, 1965, (25-year frequency) and produced 6.60 inches of rain in 24 hours. This storm had an estimated 3.29 inches of runoff which flooded 4,770 acres of land and caused an estimated $200,000 damage.

The larger floods, which occur about once in 3 years, cause almost complete crop loss. Frequent floods during April and May delay land preparation and planting on flood plain lands. Floods that occur after normal planting time make it necessary to prepare a new seedbed before replanting. As a result, broken or uneven stands are obtained, increased costs of production are incurred, and crop yields are reduced.

The frequency of flooding has caused some farmers to shift acreages of corn from the flood plain to the uplands. Pasture and hay formerly grown on the uplands have, of necessity, been shifted to the flood plain. The shift in land use has subjected the uplands to increased erosion and erosion related damage.

About 50 percent of the cropland in the watershed is in the flood plain. Due to the present flood hazard, intensified use of the flood plain has not been possible. It is estimated that crop yields have been reduced an average of 25 percent. Damage to pasture and hay crops occurs due to deposition of silt on the foliage, causing a delay in the use of pasture and a lower quality of hay.

Damage to roads within the flood plain consists of scouring of the shoulders, silting of road drainage ditches, washing away of segments of earth fill, washing off surface gravel, breaking of asphalt pavement, and erosion of portions of the roadbed and fill beneath the pavement. Damage to bridges and box culverts range from damage to abutments and approaches to complete loss of the bridge.

Other agricultural damage within the flooded area consists of livestock losses; damage to fences, watergates and farm bridges; and damage to drainage systems by the accumulation of debris. The cost of reparing this damage is often as expensive as that of replacement.

Fish and wildlife habitat is adversly affected by frequent overflow. Muddy water and silt deposits damage fish spawning areas. Floodwater and ensuing sediment damages summer and winter food and cover for wildlife.

Sediment Damage

Sediment production is moderate in the watershed. The cultivation of the rolling and steep uplands, the lack of adequate cover on much of the grassland and poor hydrologic condition of woodland have contributed to accelerated erosion. This erosion has resulted in the deposition of some

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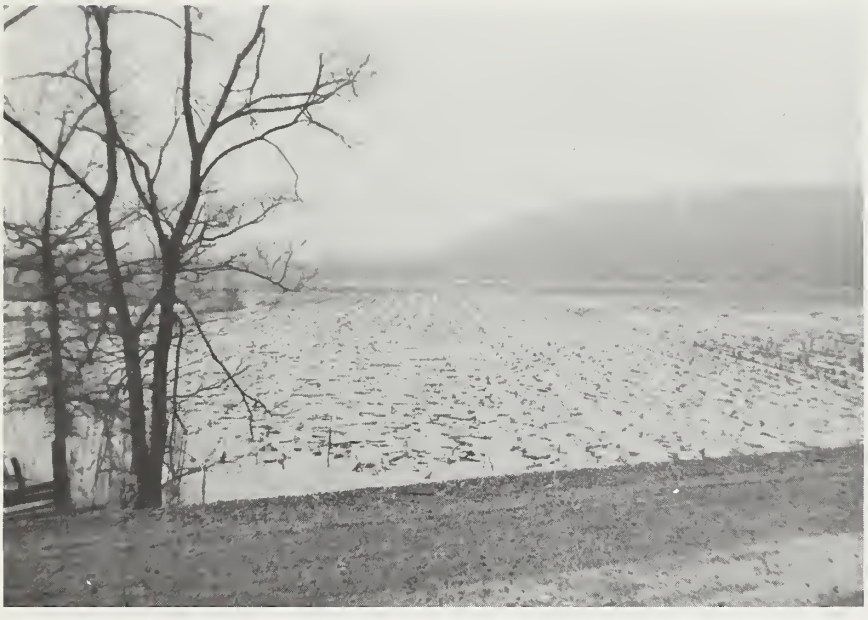
Flooding on Hurricane Creek after a 3-inch rain on March 5, 1963.



T-2609-3

Flooding of cropland near Valley Section No. 21 deposited sediment and delayed seedbed preparation.

T-2609-4

Flooding of cropland upstream from Valley Section No. 15 resulting in scour, deposition of gravel and delay of land preparation.

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Floodwater damages on Hurricane Creek after a 3-inch rain on March 5, 1963.

T-2609-5

Damage to fence is a problem to the livestock farmers.

T-2609-1

Several weeks of grazing on improved grass-clover pastures were lost. Fence damage is evident.

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Flood damage on Hurricane Creek.

T-2609-7

A 3½-inch rain on April 12, 1962 damages bridge upstream from Valley Section No. 17.

T-2609-2

A 3-inch rain on March 5, 1963 damages bridge and abutments upstream from Valley Section No. 14. School bus service, mail delivery and local travel were interrupted for several days.

Floodwater damages on Hurricane Creek.

T-2609-6

Scour damage from a 3½-inch rain on April 12, 1962. A new seedbed had to be prepared before crops were replanted.

T-1885-12

Little evidence of a fence remains near Valley Section No. 14 after a 3-inch rain on March 5, 1963. In addition, topsoil was washed away, gravel was deposited and food and cover for wildlife were destroyed.

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sediment in the stream channels or waterways. During periods of overbank flow, sediment is deposited as natural levees and infertile overwash on flood plain lands. The productive capacity of 115 acres of agricultural land has been reduced about 40 percent by infertile overwash. There are no critical sediment-producing areas in the watershed.

Erosion Damage

The continued cultivation of row crops on rolling and steep upland soils and the lack of adequate cover have contributed to the loss of top soil. The effect from the loss of top soil has reduced yields per acre, and soil deterioration is occurring. Much of this openland has been subjected to moderate sheet erosion. The average rate of gross erosion is five tons per acre per year on the upland portion of the watershed.

The damage in the flood plain is caused by scouring or erosion during periods of overbank flow. The width and depth of the scour channels and the severity of the damage is related to the depth, velocity, duration, and type as well as the amount of ground cover at the time of flood flow. The effect of these scour channels has reduced the productive capacity of 335 acres of flood plain about 35 percent.

Indirect Damage

Indirect damages in the watershed are associated with the agricultural and non-agricultural flood damages. Although these losses are less obvious, they are just as real and their effects are felt long after a flood has subsided. The indirect damages that accrue are a result of the disruption of traffic, mail delivery, and school bus service; delay and inconvenience to the traveling public; and the interruption of the management, feeding, disease control program, and marketing of livestock and livestock products.

Problems Relating to Water Management

The main and tributary stream channels have more than adequate capacities and depth for drainage requirements but lack sufficient capacities for flood prevention. There has been some improvement work of a minor nature done on Hurricane Creek and its tributaries; but since widespread coordination of effort was lacking, it has not had a lasting effect on relieving the overall problem.

There is a need for additional farm ponds to facilitate better management of pastures. Irrigation is not a problem since adequate moisture is available during years of normal rainfall for the production of crops commonly grown. No project action is deemed needed at this time to provide additional sources of water for irrigation.

Additional water for recreational purposes is not a problem; however, if water is made available by installation of the project, it will receive limited use.

The present municipal water supply for McEwen is provided by a system of three wells but is not adequate to support the anticipated needs for

industry. Wells in the area are relatively shallow and yields from presently used aquifers are erratic and generally fairly low. Deeper wells in the area have yielded highly mineralized water. The present source and system of obtaining municipal and industrial water from wells is not adequate to attract industry. The city has reserved well-located and well-served land for industrial development. Additional water sources are needed to allow projected industrial expansion.

PROJECTS OF OTHER AGENCIES

There are no soon to be constructed works of improvement (County, State, or Federal) for water resource development which will affect or be affected by the works of improvement included in this plan.

Dickson County is eligible for assistance under the Public Works and Economic Development Act of 1965.

The Hurricane Creek Watershed is located in the Duck River Basin. The Watershed comes under the purview of the Corps of Engineers, Nashville District, and Tennessee Valley Authority. These agencies have been informed of the plans and progress made in the work plan development.

PROJECT FORMULATION

Dickson County is eligible for assistance under the Public Works and Economic Development Act of 1965 (formerly the Area Redevelopment Act of 1961), but both counties have completed an Overall Economic Development Program. A comprehensive study was made to correlate a program for flood prevention on Hurricane Creek within the overall objectives outlined in the OEDP. Some of the findings of the Humphreys County Area Redevelopment Committee were: (1) that Humphreys County is far below the Tennessee average in per capita income, and that the Tennessee average, itself, is far below the U. S. average; (2) that Humphreys County farms tend to be marginal operations in income, value, and management; (3) that the Humphreys County young people tend to leave the county because there are no high-grade employment opportunities there and, in fact, little opportunity for any employment; (4) that Humphreys County woodlands are not used to proper advantage or, at least, certainly not to maximum advantage; (5) that markets within the county for agricultural produce are lacking; (6) that supply of risk capital is less than adequate; (7) by and large, it is the unskilled, male workers in the Humphreys County labor force who are unemployed or underemployed; (8) the Federal Government has purchased approximately 35,000 acres of river bottom land along the Tennessee and the lower end of the Duck River for the impoundment of water behind Kentucky Dam. This prime farmland was Humphreys County's best. This is also approximately 35 percent of all bottom land available in the county. About 16,300 acres of this bottom land is inundated now, with the rest being available for periodic flooding for flood control. Ten thousand acres of this reserve land is administered by the Department of the Interior as a wildlife sanctuary. Some 74 percent of the displaced farm families who stayed in the county are reduced to working the upland, cherty soils which

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are poorer than average. Agriculture, the county's largest single source of employment, is substantially a corn and hog economy; therefore, the necessity for making the maximum use of the remaining flood plain is vital to the overall economy of Humphreys County.

In formulating this project for flood prevention, the major consideration was the cause, amount and location of flood damage in the flood plain. The nature of these damages was discussed with the local sponsoring organizations so there would be a common understanding of the type and degree of protection that might be expected from any control program installed in the watershed.

Project formulation was based on the objectives agreed upon with the sponsoring local organizations. The objectives are many-fold in purpose: (1) to significantly improve the rate of establishing soil and water conservation measures; (2) to obtain a reduction in flooding on 75 percent of the flood plain to the extent that cultivated row crops, hay and pasture, in rotation, can be managed more intensively at least two years out of three; (3) to reduce to a minimum, the flood damage to roads, bridges, and other fixed improvements; (4) to provide the city of McEwen with a source of industrial water; and (5) to maintain the present fishery resources in Hurricane Creek.

Land treatment measures are considered one of the basic elements in formulating a watershed project and are essential if it is to function successfully. Land treatment measures included in this plan were selected on the basis that they will: (1) be effective in reducing erosion damage on existing cropland; (2) reduce runoff and sediment production that would adversely affect operation, maintenance, and the useful life of the proposed works of improvement; (3) be necessary to assure the realization of benefits used in justification of structural measures for flood prevention; and (4) increase the efficiency of land use on existing farms.

The selection of the structural works of improvement was guided by the objectives of the Sponsoring Local Organization, physical characteristics of the watershed, and appropriate engineering criteria. The presence of limestone bedrock, gravel deposits, and fishery values limits the stream channel improvement that could be accomplished economically and places the burden of meeting the desired level of protection on floodwater retardation.

Nineteen physically adapted sites for floodwater retarding structures were selected for evaluation. These sites were located on Lateral 2, Lateral 3, Yellow Bank Branch, Stewart Branch, Dogwood Branch, Sawmill Branch, Warner Branch, Culvert Branch, Lateral 4, Lateral 5, upper Little Hurricane Creek, Martin Branch, Lateral 7, Marker Branch, Lateral 8, Lateral 9, main Hurricane Creek at Valley Section 13, main Hurricane Creek at its confluence with Dogwood Branch, and Little Hurricane Creek near Valley Section 11. Alternate combinations of these floodwater retarding structures in conjunction with stream channel improvement were analyzed to determine a program that would be economically feasible and provide an acceptable level of protection. Stream channel improvement would supplement the land treatment and structure program in providing more protection. The eight structures proposed in this plan, however, provide an acceptable level of flood protection. Stream channel improvement is not included.

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The desire of the officials of McEwen is to develop the many assets of the city and surrounding area. The people appear to have the greatest potential for development. The labor force which is about 90 percent native born with an average junior high school education is readily trainable. Workers are exceptionally eager to learn and have the ability to absorb training rapidly. Certain innate skills, particularly manual dexterity, appear to be inherited from pioneering ancestors.

The present water supply furnished by three wells is adequate for the present population. The wells are relatively shallow (200-250 feet depth) and yields are estimated to be 100,000 to 150,000 GPD. Deeper wells usually yield highly mineralized water (sulfur). The objective is to provide the growing population with an adequate and safe source of water. The present water requirements have been met but it is evident that a need exists for additional water for future industrial use. Expansion of a new water supply system will attract new industry into the area and improve the employment opportunities of its citizens. In the past four or five years, four manufacturing companies have negotiated with the city of McEwen indicating a desire to locate in the area. The companies would not locate in the area since wells were the only source of water.

The city realizing the importance of water in its industrial development program hired a private engineering firm to study the potential growth patterns, needs, develop alternative costs, and make recommendations. The anticipated future needs for industrial water and municipal growth were estimated to be 327,000 GPD. The most reliable and feasible method of this supply was determined to be the impoundment of surface water.

During the formulation of this project, the city of McEwen decided to develop a structure for multiple-purpose flood prevention and industrial water supply. The volume of storage to satisfy the projected needs of the city as determined by private engineers was 120-acre-feet. The base flow of Yellow Bank Branch is estimated to be 150-200 GPM. A preliminary design and cost estimate was prepared to determine potentials for development of Site No. 3A as a multiple-purpose dam. Representatives of the Soil Conservation Service, McEwen city officials and private consultant engineers discussed the feasibility of Site No. 3A for impounding industrial water. The site was selected for storage of industrial water based on its close proximity to the city, favorable geologic conditions, size of drainage area, anticipated land use, water quality, and estimated cost.

In determining the overall structural program, consideration was given to incremental benefits, costs, degree of protection and displacement of people. The structural program presented in this plan is the best of several proposals which were considered. The eight dams proposed will not require the displacement of people, business or farm operations. An alternative proposal studied which included a large dam on main Hurricane Creek at its confluence with Dogwood Branch would have displaced seven families, a church, six graves, and four barns, and modification or relocation of about a mile of gravel road. This proposal is not included in the plan.

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Preliminary designs with cost estimates for a recreational development with minimum basic facilities were made. The Sponsoring Local Organization did not feel that they could undertake the financial obligations of installing, operating, and maintaining a recreational development in competition with existing facilities within the county.

The selection of measures that would effectively mitigate the damage to fish and wildlife was made after a careful study of the extent and composition of the present fish and wildlife resources within the watershed and the effect on these resources by the proposed structural measures for flood prevention. The installation of the floodwater retarding structures will reduce the flooding on land adjacent to Hurricane Creek.

Mitigation for waterfowl was not found necessary. Several proposals were considered for fish management, but only two were found to be practical and adequate. These measures are: (1) to modify the principal spillway to include a submersed inlet for removing the normal base inflow from near the bottom of the reservoir to avoid increasing the temperature of the flow in the downstream channel, and (2) to install a vertical slide gate within the submersed inlet to enable the water level of the sediment pool to be effectively varied for fish management.

This plan has been coordinated with the Tennessee Historical Commission. Investigations by the commission indicate that installation of the project will not encroach on any known archeological values, any historic place or any planning by the commission for historic preservation. At Hurricane Mills a beautiful ante-bellum home built by George W. Hillman is located on a hill overlooking a 75-year old mill and dam that stretches across Hurricane Creek. The mill and dam will be retained in its present status as a historic monument.

WORKS OF IMPROVEMENT TO BE INSTALLED

The planned works of improvement to be installed are: (1) the accelerated application of needed conservation treatment measures on 7,575 acres of land; (2) the installation of seven floodwater retarding structures; (3) the installation of a multiple-purpose structure for flood prevention and storage of industrial water for the city of McEwen; and (4) the installation of measures that will mitigate damages to fishery habitat. Kinds of measures, quantities, and distribution of installation costs between P. L. 566 funds and Other funds for the total project are shown on table 1.

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Land Treatment Measures

The land treatment measures to be installed on 7,575 acres of land will have a measurable physical effect on the watershed. These measures will improve the hydrologic condition, decrease runoff, erosion and sediment production, and assure the realization of benefits used in project justification. These planned land treatment measures will be installed at an estimated cost of $286,200.

Voluntary conservation planning is a prerequisite to successful application of a soil and water conservation program. Technical assistance will be provided to the farmers for planning and applying land use adjustments and will include soil surveys on 52,780 acres. The adjustments, together with conservation and management practices, will be worked out with the individual farmers in harmony with the overall land use and water disposal plan for the watershed. The resulting Conservation Plans will be in accordance with needs for sustained productive land use on the individual farms.

Alternative measures and land use will be in keeping with technical standards used in obtaining effective soil and water conservation. Alternative land use and conservation measures that are needed for the conservation, development, protection, and improvement of the individual farms may be installed.

The conservation measures planned on 3,000 acres of cropland will consist of conservation cropping systems, contour stripcropping, gradient and parallel terraces, grassed waterways, cover and green manure crops and field drainage ditches. The application of these measures on cultivated land will enhance periodic use of high residue producing and soil conditioning crops, provide an adequate means for controlled disposal of excess surface water, increase the infiltration rate of the soils, increase available moisture holding capacities, and reduce runoff and sheet and gully erosion.

The treatment of 2,100 acres of grassland will consist of needed conservation measures such as grassed waterways, perennial hayland and pasture plantings, renovation of pasture and hayland, pasture and hayland management, and the construction of surface field ditches and diversions. Twenty farm ponds with wildlife habitat will be developed on 15 acres of miscellaneous land. Shifts in land use from cropland or idle to grassland and the application of the above measures will contribute materially to the

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establishment of a sound livestock grazing program, facilitate more uniform distribution of grazing, and permit a management level that will provide more effective ground cover to control runoff and erosion.

Woodland improvement on 2,460 acres will consist of tree planting and hydrologic stand improvement. Trees will be planted on 330 acres of idle or open land to improve watershed conditions by land use conversion and stand improvement. These areas are not critical sources of sediment or storm runoff but are lands which are better suited to the production of trees. Their ability to take in and temporarily store rainwater will be increased and a ground cover will develop which will reduce soil loss from the lands. Stand improvement measures on 2,130 acres of forest land are aimed at improving hydrologic conditions by manipulation of stand composition to create favorable conditions for maximum production and protection of litter, humus, and forest cover. They include removal of inferior species and cull trees, improvement, release and harvest cuttings, and protection from fire and grazing. Hudrologic stand improvement is needed on about 60 percent of the upland forest area.

Wildlife food and cover needs will be planned as a part of the adjustments in land use and land treatment program in the watershed. Individual landowners will be provided technical assistance in planning and carrying out practices that will enhance the supply of wildlife food and cover on the farms. A timber management program that favors woodland wildlife habitat will be encouraged and recommended. Farm ponds can be important for fish production and the area surrounding the pool will be excellent habitat for wildlife. Wildlife habitat improvement will include plantings for food and cover along field borders, stream banks, drainage ditches, fences, and other open areas.

The practice of general farming prevails and the trend is toward increased rotation of crops in order to maintain fertility and produce an ample supply of forage and grain for livestock feed. The basic concept in the rotation is a cultivated crop followed by a cover crop and then a grass or grass-legume mixture. The land treatment measure to be installed will meet the needs, desires, and objectives of the individuals and will vary with the land use, economic conditions, acreage controls, customs, trends, conservation needs, and flood reduction.

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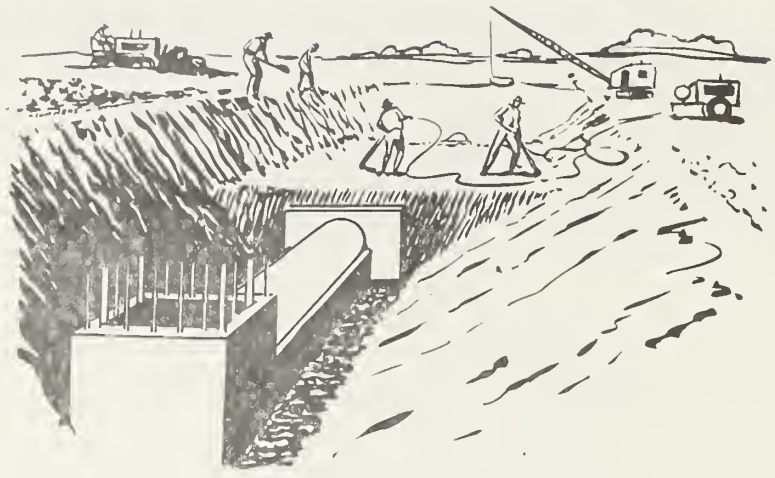

The planned works of improvement to be installed are seven single-purpose floodwater retarding structures and one multiple-purpose structure for floodwater detention and storage of water for industrial use, and modification of risers of the principal spillway on single-purpose floodwater retarding dams to preserve and replace fishery habitat. The total estimated installation cost of these measures is $1,802,900.

The seven floodwater retarding structures and one multiple-purpose structure will detain 3.78 inches of runoff from 26 percent of the drainage area of the watershed above valley section No. 22. The total floodwater detention capacity is 3,969 acre-feet. The principal spillway and floodwater storage volumes are proportioned so emergency spillways of all structures will flow an average of only once in about 50 years.

Provisions are made in all structures for 100-year sediment storage. The crest of the low stage orifice in the principal spillway of the seven single-purpose structures will be set at an elevation equivalent to the 100-year submersed sediment storage. The crest of the principal spillway of multiple-purpose structure No. 3A will be set at an elevation to store the 100-year submersed sediment and the industrial water.

The earth embankment of the dams will be built primarily of clayey gravels with some silty gravels and silty and gravelly clays. Principal spillways for the dams will consist of a reinforced concrete riser and pipe conduit with a metal slide headgate located near the bottom of the riser to facilitate lowering the water level for vector control and draining of the reservoir as needed. Emergency spillways of dams No. 11A and 13 will be excavated in rock. The emergency spillways of dams No. 3A, 6, 8, 9, 10, and 14 will be excavated in erosion resistant, cherty redidual materials and vegetated.

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The embankments, emergency spillways, and other areas within the easement areas that are disturbed during construction will be stabilized with suitable vegetation. The vegetative plantings will be established from fescue or any other suitable vegetation by seeding, mulching, fertilizing, liming, and proper management. The seeding will be done in conjunction with shaping and preparation of an adequate seedbed. These plantings will be fenced as needed to protect from overgrazing and to insure proper maintenance.

Special efforts will be made during construction of the dams to control sediment pollution. Silt basins and diversions will be built to control sediment washed from borrow areas. Useable spoil material will be stockpiled during construction to minimize pollution. Entrance and haul roads will be watered as needed and located on the contour when possible with drainage entering above the dam when practical. Vegetation, permanent or temporary, will be estimated as soon as possible after construction. Other pollution control measures will require proper disposal of oil, filters, and other waste material as well as carefully selecting the location for equipment parking.

The presence of highly permeable alluvial materials in the foundations of the dams, cavernous limestone areas, and the erratic occurrence of foundation rock will require treatment to assure stability of the structures. Foundation treatment is expected to include placement of cutoff trenches, installation of foundation drains, grouting of cavernous limestone areas, and excavation of highly weathered foundation rock and rock boulders and overhangs. Treatment will only be used to assure structural stability and no federal funds will be expended to assure water retention in the sediment pools. To function as floodwater retarding structures, it is not necessary for the sediment pools to retain water. Foundation treatment will be based on detailed geologic investigations of the sites and will be tailored to their individual needs.

The installation of the dams will require removing, relocating, or modifying some fixed improvements within the easement areas. A frame house within the easement area of Site No. 8 and a log house and other out-buildings within the easement area of Site No. 13 will be removed from the easement areas and relocated on adjacent property as designated by the landowners. About 7,000 feet of gravel road within the easement areas of Sites 11A, 13 and 14 and about 6,000 feet of utility lines within the easement area of Sites 10 and 13 will be relocated, modified or altered to insure continued use.

The seven single-purpose floodwater retarding structures will be installed at a total estimated cost of $1,448,300, Table 2. The annual cost, including operation and maintenance of $3,570, is $78,288.

Based on preliminary foundation investigations of multiple-purpose Site No. 3A, installation of positive cutoff appears feasible and the site is expected to hold water for industrial use. A more detailed investigation

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will be needed to confirm the site's water-holding ability. This confirmation will be made by engineers representing the city. An additional $14,000 is included in the construction cost for foundation treatment for structural stability and to provide positive cutoff.

Multiple-purpose structure No. 3A is for floodwater detention and storage of industrial water. Total storage in the structure is 480 acre-feet, consisting of 120 acre-feet for industrial water, 98 acre-feet for sediment storage and 262 acre-feet for floodwater detention. In addition to the pipe conduit in the dam, a special water outlet structure will be installed through the dam as an appurtenance.

The total estimated installation cost of multiple-purpose structure No. 3A and water outlet structure is $219,000, and the annual cost, including operation and maintenance of $430, is $11,728.

The construction of the seven single-purpose flood prevention dams and the multiple-purpose flood prevention and industrial water supply dam will require about 561 acres of land rights for the sediment pools, fill, borrow areas, emergency spillway areas, detention pools and water supply pool. The present land use and cover condition on this area is as follows:

Land Use and Cover Conditions	Acres
Cropland	270
Corn	71
Rotational Hay	52
Wheat	10
Other Crops	22
Rotational Pasture	115
Grassland	112
Woodland	140
Misc. (includes channels)	39
TOTAL	561

Mitigating Measures

The principal spillway of the floodwater retarding structures will be modified to include a submersed inlet. This inlet will be an appurtenance to the principal spillway and will consist of a vented tube that extends from slightly above the surface of the sediment pool to a predetermined depth. This modification will take the normal base stream flow from near the bottom of the sediment pool to avoid increasing the downstream water temperature. For the submersed inlet to be effective, the bottom of the inlet will be located one to two feet above the valley floor. One foot should be used when the present ditch or stream bottom is more than three feet below the valley floor and two feet when the stream is less than three feet below the valley floor.

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A vertical slide gate will be installed on the riser of the principal spillway and within the submersed inlet. The bottom of the gate will be located at the elevation that will decrease the surface area of the sediment pool by about 50 percent. The gate will be of sufficient size to lower the water level within 10 days or less. The purpose of this gate is to enable the water level of the sediment pool to be effectively lowered for fish management.

The total estimated cost to modify the risers of the principal spillways is included as an item of construction.

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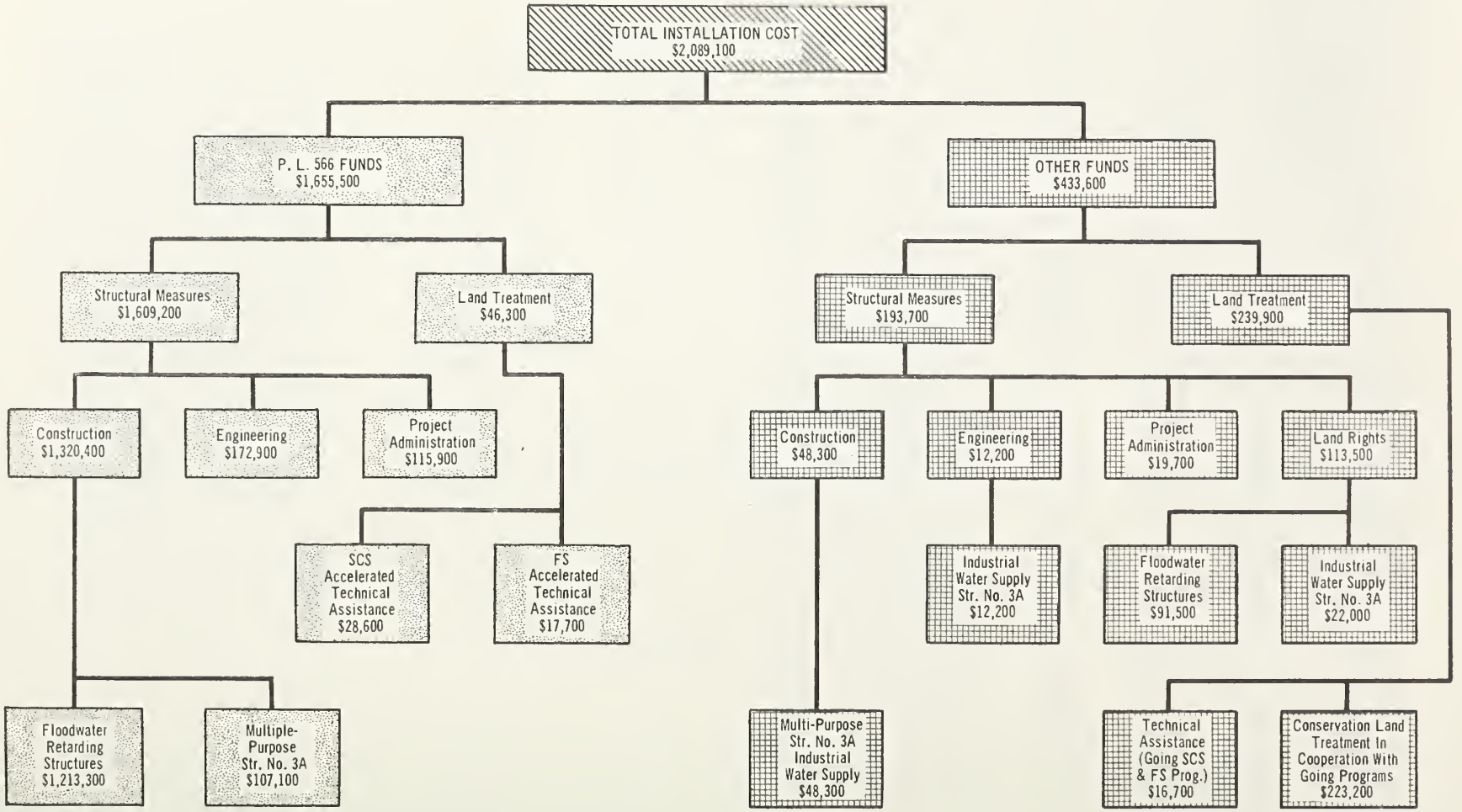
EXPLANATION OF INSTALLATION COSTS

The total estimated installation cost of the project is $2,089,100. of which $1,655,500. or about 79 percent will be P. L. 566 funds and $433,600. or about 21 percent will be Other funds.
The following chart illustrates the distribution of cost as outlined in table 1.



These estimates represent all of the direct and indirect cost items to install the project measures such as labor, materials, machinery, etc.

Land Treatment Measures

The land treatment measures have an estimated installation cost of $286,200--Public Law 566 funds will furnish $46,300 and Other funds will furnish $239,900.

The forest land treatment program has an estimated installation cost of $60,100. The cost of technical assistance is estimated to be $20,300, of which $17,700 will be provided under P. L. 566; the U. S. Forest Service, by and through the Tennessee Division of Forestry, will provide $2,000; and the going Cooperative Forestry Management Program will provide Services valued at $600. The landowners and operators will furnish about $39,800 for installation of the measures.

All other land treatment has an estimated cost of $226,100; $197,500 will be Other funds and $28,600 will be P. L. 566 funds for accelerated technical assistance which includes about $14,600 for soil surveys and about $14,000 for the preparation and application of conservation plans.

It is expected that financial assistance will be used as available through the Rural Environmental Assistance Program or other going programs.

The goals for land treatment measures were based on field surveys and were adjusted to meet expected landowner participation. Installation costs were based on prices paid by landowners. Technical assistance costs were based on the present cost of the going Soil Conservation District and Cooperative Forest Management Programs.

Structural Measures

The estimated installation cost of the seven single-purpose floodwater retarding structures for flood prevention and fishery mitigation is $1,448,300. The cost to be borne by P. L. 566 funds for construction and engineering services is $1,356,800. The estimated construction cost of $1,213,300 includes $11,000 for modification of risers on principal spillways and $89,800 for contingencies, and $319,600 for foundation treatment to insure structural stability. Estimated cost for engineering services is $143,500, which includes the direct cost of engineers and other technicians for surveys, investigations, design, and preparation of plans and specifications for structural measures, including the vegetation. The cost of engineering does not include similar services for land rights.

The installation cost to be borne by Other funds is estimated to be $91,500 for land rights. The acquisition of land rights needed to construct the dams will not require the displacement of any person, business or farm operation as described in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The land rights costs include

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$6,900 for relocating a frame house, a log house, a barn and other outbuildings. The land rights costs also includes $21,800 for relocation, modification or alteration of about 7,000 feet of gravel road and about 6,000 feet of utility lines.

Joint costs for construction, land rights and engineering for installation of multiple-purpose structure No. 3A are allocated 75 percent flood prevention and 25 percent industrial water supply. The specific cost of the water outlet structure is allocated to industrial water.

The Soil Conservation Service will provide from P. L. 566 funds for installation of multiple-purpose structure No. 3A:

(1) 75 percent of the total construction cost, and

(2) 75 percent of the total engineering services, or payments made for architectural and engineering services secured for surveys, investigations, design, and preparation of plans and specifications of the dam.

The City of McEwen will provide from Other funds for installation of multiple-purpose structure No. 3A:

(1) 25 percent of the total construction costs of the dam,

(2) 25 percent of total engineering services or payments made for architectural and engineering services secured for surveys, investigations, design, and preparation of plans and specifications for dam,

(3) 100 percent of the cost of land rights,

(4) 100 percent of the specific costs for construction of water outlet structures, and

(5) 100 percent of the specific costs for engineering services of the water outlet structure.

The following table illustrates the allocation of cost to purposes and cost-sharing between P. L. 566 funds and Other funds for multiple-purpose structure No. 3A.

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COST-ALLOCATION AND COST-SHARING

Item	Purpose				Total	Recapitulation	
	Flood Prevention			Industrial Water Supply		P. L. 566 Funds	Other Funds
	P. L. 566 Funds	Other Funds	Total				
	MULTIPLE-PURPOSE STRUCTURE NO. 3A						
Joint Cost (Dam)							
Construction	107,100	0	107,100	35,700	142,800	107,100	35,700
Engineering Services	29,400	0	29,400	9,800	39,200	29,400	9,800
Land Rights	0	16,500	16,500	5,500	22,000	0	22,000
Specific Costs (Wtr. Outlet Str.)							
Construction	0	0	0	12,600	12,600	0	12,600
Engineering Services	0	0	0	2,400	2,400	0	2,400
GRAND TOTAL	136,500	16,500	153,000	66,000	219,000	136,500	82,500

The Soil Conservation Service and the Local Sponsors will each bear the costs of project administration which it incurrs, estimated to be $115,900 and $19,700, respectively. Project administration costs are those costs associated with administering the installation of structural measures. P. L. 566 funds will be used for reviewing engineering plans and for providing inspectors to insure that structural measures are installed in accordance with plans and specifications.

Other funds will be used to provide for contract administration, legal fees, court hearings, land acquisitions, and other general administration costs of the local sponsors. The sponsoring local organizations will provide without P. L. 566 cost-sharing, the engineering, legal, and administrative costs incurred for acquiring land rights. The sponsors will, at their own option and without P. L. 566 cost-sharing, inspect the installation of any portion of works of improvement.

The following is an estimated schedule of funds for a 5-year project installation period and covers land treatment and structural measures. The schedule may be adjusted from year to year on the basis of any significant need and with consideration given to the project measures completed and appropriations actually made available by the Federal government.

SCHEDULE OF ESTIMATED INSTALLATION COSTS
Hurricane Creek Watershed, Tennessee

Project Year	Estimated Cost (Dollars)				
	Land Treatment		Structural Measures		Total
	Non-Federal Land		Non-Federal Land		
	P. L. 566 Funds	Other Funds	P. L. 566 Funds	Other Funds	
First	9,600	49,100	30,000	23,800	112,500
Second	15,100	61,400	352,600	70,900 1/	500,000
Third	8,400	73,600	579,700	67,700	729,400
Fourth	3,700	36,800	349,900	26,300	416,700
Fifth	9,500	19,000	297,000	5,000	330,500
TOTAL	46,300	239,900	1,609,200	193,700	2,089,100

1/ About $60,500 of P. L. 566 funds will be used to finance the local contribution for industrial water supply on a deferred repayment (P. L. 566, Sec. 2).

EFFECTS OF WORKS OF IMPROVEMENT

The proposed works of improvement in the Hurricane Creek Watershed constitutes a needed and harmonious element in the overall economic development program for Humphreys and Dickson Counties. The installation of project measures will directly benefit at least 11,695 acres of land consisting of

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4,820 acres of flood plain and 6,875 acres of upland. The economic benefits used in project justification as well as the financial and technical assistance provided as a result of project installation will have a socio-economic impact on the community and surrounding area by improving, conserving, and utilizing the available natural and human resources.

This project will directly benefit thousands of people who live, travel, or work in the watershed. At least 2,500 citizens now occupying or utilizing watershed facilities will be directly or indirectly benefited. About 60 percent of the 170 farms will receive direct benefits. The storage of water for industrial use will benefit all the residents of the city of McEwen and surrounding area.

The installation of proposed project measures will reduce damage in the problem areas as follows:

Problem Area	Percent Damage Reduction
Crops and Pasture	78
Other Agricultural	83
Roads & Bridges	93
Overbank Deposition of Sediment	78
Flood Plain Erosion (Scour)	78
Indirect	88
Sheet Erosion	29
Suspended Sediment Concentration	16

It is estimated that 4,820 acres of flood plain will be directly benefited by the installation of floodwater retarding structures. The area inundated by the January 29-30, 1956 (25-year frequency) flood will be reduced about 27 percent. Flooding will be less frequent than once in 3 years on 70 percent of the flood plain upstream from Valley Section No. 22.

Reduction in the flood hazard will permit farmers to increase their levels of management and technology and contribute to their peace of mind and well-being. The protection afforded will stimulate farmers to fertilize more efficiently for higher crop yields, use improved varieties of seeds, select high income producing crops, and to be more proficient in the timing of their farming operations. Farm income will be enhanced due to a decrease in unit cost of production, an increase in mechanization, and an increase in efficiency when row crops are moved from the uplands to the flood plain. With reduced risk, more intensive land use becomes profitable both in terms of crop selection and levels of intensification.

Most of the tributary streams of Hurricane Creek are spring fed with base flows of one to three cfs. The cover conditions of the drainage areas range from 50 to almost 100 percent woodland. There are no known major sources of pollution in the watershed. The present water quality is

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satisfactory for municipal, industrial or recreational uses. The water quality at each of the structure sites, particularly site 3A, will meet the quality standards adopted by the Tennessee Department of Public Health for municipal, industrial or recreational uses. Water quality data of random samples collected from Hurricane Creek and its tributaries are listed below:

Water Quality Data

Parameter	Sample Location			
	Hurricane Creek Near Hurricane Mills	Vanden Branch	Little Hurricane Creek	Yellow Bank Branch (Site No. 3A)
PH	7.4	7.4	7.6	7.4
Temperature (^{o}F)	76.0	70.0	68.0	70.0
Dissolved Oxygen (PPM)	8.0	8.0	8.0	8.0
M. O. Alkalinity (PPM)	119.7	86.0	137.0	154.0
Total Hardness (PPM)	119.7	68.0	137.0	137.0

The 120 acre-feet of water stored in structure No. 3A for industrial purposes will increase the economic opportunities for low income families in the city of McEwen and surrounding area. Improvement in the social and economic environment of this rural community will enhance the city's potential to encourage and attract new industrial development. During the past four to five years three wood products manufacturing companies and an electronics manufacturing company have refused to locate in the area since wells were the only source of water.

The development proposed for McEwen will help avoid overconcentration of people in the already overcrowded Metropolitan area in search of steady employment. Better employment and a higher standard of living will be provided, thus reducing the outmigration of the unemployed or underemployed and the younger people as they graduate from high school. The water supply will directly benefit all the present 1,237 residents of the city and the projected 2,100 residents by the year 2000.

The projected growth of McEwen will create new demands for the available natural resources, especially land. The increases in capital value of land to private interests will result in additional employment opportunities, increased business, an increased tax base, and utilization and appreciation of an under-developed natural scenic resource.

The storage of 120 acre-feet of industrial water in dam No. 3A will supplement the estimated 100,000 to 150,000 gpd water supply furnished by the present wells. It is estimated that Yellow Bank Branch (Site No. 3A) will provide base flows of 150 to 200 gpm. An impoundment to store the base flow plus surface runoff will provide a dependable water supply for industrial uses and provide for normal municipal growth of this rural community.

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Cost-price relationships will require shifts in land use as values of existing developments decrease with the introduction of new products and the desire for a higher standard of living.

Local secondary benefits will accrue in the watershed and the surrounding areas due to the installation of project measures. Goods and services produced as a result of the project will tend to stimulate local activity on a permanent basis. Products produced will require additional services from within the area. Profits will also be realized from the sale of agricultural products by dealers and processors not directly benefited by the project. Expenditures for management inputs such as fertilizers, seed, machinery, and other needed materials will provide added profits to those who supply these materials and services.

Benefits will accrue to the financial and technical assistance made available for the installation of the watershed project. The project will bring outside resources into the community and will provide an opportunity to use goods, services, and labor from the local area. The employment of unemployed or underemployed local labor will be needed during installation and will provide for continuing employment for normal operation and maintenance.

The protection afforded by the project will permit land use adjustments of the flood plain and upland. The installation of measures for watershed protection and flood prevention will enhance aesthetic values and preserve the land for future generations. Estimates indicate that there will be no increase in the total acreage of allotted crops within the watershed. Future land use is estimated to be:

Land Use	Acres	Percent
Cropland	7,076	13
Grassland	5,818	11
Woodland	37,318	71
Miscellaneous	2,568	5
TOTAL	52,780	100

Conservation measures will provide more adequate cover, improve infiltration and physical conditions of the soil, contribute to the control of excessive runoff, reduce erosion and sediment production, increase income potential, and aid in maintaining the effectiveness of group facilities.

More than 1,427,000 tons of sediment will be stored behind the floodwater retarding structures during the evaluation period of the project. Without the project, this material would be available for transport downstream.

The reduction in damage to roads, bridges, and other public property will make it possible for local units of government to divert funds that would have to be spent for repair and replacement of these facilities to better educational and health opportunities. Private funds used for repair of damage can be shifted to the amenities of life.

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Installation of the floodwater retarding structures will provide an increase in fishing waters for the next generation. Installation of the submersed inlet and the vertical slide gate on the principal spillway will mitigate the downstream loss to fish production. These submersed inlets and vertical slide gates on the principal spillways will allow effective water level management. This will provide a better fish management program than would be possible without such facilities for fluctuating the water level. These facilities will also aid in the control of aquatic vegetation. To further develop the recreational opportunities of these structures adequate sanitary facilities should be installed; however, since no provisions have been made to provide even limited facilities, these areas will be reserved for the rugged outdoorsmen such as hunters and fishermen or the sponsors will discourage active recreational use.

The application of conservation measures on 7,575 acres, which includes 700 acres of flood plain, is in the public and private interest. All land within the watershed is eligible to receive assistance from the going and accelerated conservation programs. The objective of individual farmers, especially those of low income, is to improve their socio-economic position by developing a long-range plan that will result in the highest net family income. The plan would be based on suitable alternative land uses and needed conservation treatments for sustained productive use of the soil resources as well as the objectives of the land user.

PROJECT BENEFITS

The average annual benefits used in justification of the floodwater retarding structures and multiple-purpose structure No. 3A are estimated to be $149,345, Table 6.

The average annual flood damage without the project is estimated to be $111,073, and the estimated benefits from flood damage reduction are $92,084, Table 5. These benefits consist of reduction in crop and pasture damage amounting to $39,193; other agricultural, $5,525; road and bridge, $21,958, overbank deposition of gravel, $4,328; flood plain scour, $7,069; and indirect, $14,011.

The estimated more intensive land use benefits of $37,310 will accrue as a result of flood prevention. These benefits are estimated on the basis of the difference in net returns with and without the project, and consideration was given to farmer participation, the capability of the soils and their potential productivity.

The value of local secondary benefits that will accrue in the watershed and surrounding area due to project installation amounts to $13,532. The value of secondary benefits from national viewpoint are not considered in the economic evaluation or justification of this project.

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It is estimated that annual benefits will accrue to the industrial water supply in the amount of $7,500.

Research and experience have demonstrated that the combined private and public benefits derived from land treatment measures will exceed their costs of installation. The physical effects of land treatment measures included in this plan were estimated but no specific determinations of monetary benefits from the installation were made from their economic justification. The annual benefits accruing as a result of the installation of land treatment measures for watershed protection or flood prevention were not used in the economic justification of floodwater retarding structures or stream channel improvement.

COMPARISON OF BENEFITS AND COSTS

The estimated average annual cost to install, operate and maintain the project structural measures is $97,012. The average annual benefits used in project justification are estimated to be $149,345. The benefit-cost ratio accruing as a result of total project benefits is 1.5:1.0, Table 6, and the benefit-cost ratio without secondary benefits is 1.4:1.0.

PROJECT INSTALLATION

The sponsors of the Hurricane Creek Watershed project plan to install the land treatment and structural measures during a 5-year period. The dams will be built as a construction unit during the last 4 project years. The actual sequence of construction will depend on: (1) agreements from not less than 50 percent of the owners and operators to carry out recommended soil and water conservation measures; and (2) order of obtaining land rights.

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The anticipated plan for installation of project works of improvement is:

Project Year	Item
1	(1) Install 20 percent of accelerated land treatment. (2) Acquire land rights for dam 11A. (3) Prepare designs for dam 11A.
2	(1) Install 26 percent of accelerated land treatment. (2) Construct dam 11A. (3) Acquire land rights for dams 3A, 9, and 13. (4) Prepare desings for dams 3A, 9, and 13.
3	(1) Install 31 percent of accelerated land treatment. (2) Construct dams 3A, 9, and 13. (3) Acquire land rights for dams 10 and 14. (4) Prepare designs for dams 10 and 14.
4	(1) Install 15 percent of accelerated land treatment. (2) Construct dams 10 and 14. (3) Acquire land rights for dams 6 and 8. (4) Prepare designs for dams 6 and 8.
5	(1) Install 8 percent of accelerated land treatment. (2) Construct dams 6 and 8. (3) Final inspection of project measures and close project.

Land treatment measures will be voluntarily planned and applied by the landowners in cooperation with the going and accelerated program of the Humphreys and Dickson County Soil Conservation Districts. The Soil Conservation Service will provide technical assistance for the preparation and application of conservation plans and will accelerate, from P. L. 566 funds, the technical assistance to the going district conservation programs.

The Humphreys and Dickson County Soil Conservation Districts will obtain agreements from landowners and operators to carry out conservation farm plans on not less than 50 percent of the land in the drainage area of each structure. These agreements will be obtained before P. L. 566 funds are provided for construction of the dam.

The sponsors will encourage landowners to apply and maintain the forestry measure that will enhance woodland production through good watershed management. Improved protection from fire will be necessary on many areas for the success of watershed forestry measures. Trained personnel of the Tennessee Division of Forestry will advise and assist the sponsors in this matter. During the installation of the watershed project, the going Cooperative Forest Management Program will be continued at its present level. An estimate of the State-Federal matched funds to be used for this going program is included in the other cost of forestry technical assistance shown on Table 1.

Humphreys County will be responsible for installing the single-purpose flood prevention measures. The county has sufficient legal authority to raise funds and the power of eminent domain to acquire all land rights needed to install the project measures for flood prevention. This legal

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authority will be used as needed to insure the orderly progress in installing the planned works of improvement. The county will obtain all needed land rights and will be responsible for the costs of engineering and legal services for acquisition of the single-purpose flood prevention measures.

The Soil Conservation Service will provide Humphreys County the engineering and technical assistance needed for design, preparation of specifications, inspection of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of all planned single-purpose works of improvement for flood prevention.

The city of McEwen will be responsible for installing multiple-purpose dam No. 3A. The city has sufficient legal authority--including raising of funds through taxation of assessments and the power of eminent domain--to acquire all land rights. This legal authority will be used as needed to insure the orderly progress in installing the planned measure. The city will obtain all needed land rights and be responsible for the costs of engineering and legal services for the acquisition.

The sponsors will comply with the provisions contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) and the regulations issued by the Secretary of Agriculture pursuant thereto.

The construction plans and specifications for multiple-purpose dam No. 3A will be prepared by private engineers furnished by the city of McEwen through negotiated A&E contracts. The A&E contracts will provide for surveys, investigations, design, and preparation of plans and specifications for construction of dam No. 3A.

The Soil Conservation Service will participate with the city of McEwen in the A&E contract negotiations. The Service will administer the A&E contracts, review and approve engineering plans prepared by contract, inspect construction, prepare contract payment estimates, perform final inspection, execute certificates of completion, and perform related tasks to insure that the measures are installed in accordance with plans and specifications.

Humphreys County and the city of McEwen will assume the responsibility for administering their respective contracts. The sponsors, at a later date, may request the Soil Conservation Service to administer the contracts. The sponsors will, at their own option and without P. L. 566 cost-sharing inspect the installation of any portion of the works of improvement.

The National Park Service and other Federal, State and local agencies will be kept informed on progress of the project. These agencies will be notified if artifacts or other items of archeological historic significance are uncovered during construction so that evaluation and salvage operations can be carried out.

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Roads, houses, barns, and electric powerlines involved in the floodwater retarding structure sites will be altered, modified, or relocated as agreed upon by the sponsoring local organization, the local branch of government responsible for roads, and the Service. The sponsoring local organizations will be responsible for the disposition of these facilities and other land rights matters.

The sediment pools of the floodwater retarding structures, and multiple-purpose structure No. 3A can be correctly stocked with fish. These fish can be obtained from Federal, State, or private hatcheries. Technical assistance will be provided by the Soil Conservation Service and the Tennessee Game and Fish Commission in stocking and managing these pools for fish production. The dams will be constructed to conform with health requirements and regulations of the Tennessee Department of Public Health.

FINANCING PROJECT INSTALLATIONS

The land treatment measures will be voluntarily installed by the landowners and operators at their own expense. Cost-sharing assistance now available under the Rural Environmental Assistance Program or other going program will be utilized in applying these measures.

Humphreys County has initiated negotiations with the Farmers Home Administration by filing a letter of intent to finance their share of the project installation costs for land rights and project administration by utilizing the loan provisions of Section 8, P. L. 566, as amended. The county's cost is estimated to be $109,200. The county will repay its loan through regular sources of revenue. The amount of funds needed will be determined so as to meet the loan repayment needs and the annual operating expense needed to adequately maintain the works of improvement.

The incorporated city of McEwen will assume the financial responsibilities for the installation of multiple-purpose structure No. 3A. The city will use two loans from Farmers Home Administration to finance their share of the project installation cost. One loan will have a deferred repayment to pay costs allocated to industrial water. The second loan is to acquire land rights. A letter of intent has been filed with FHA and tentative approval has been granted by the State Director to pay the estimated $60,500 cost for construction and engineering services to include the cost of installing the water outlet structure for release of withdrawal of stored water. The city will execute an agreement for repayment of the advanced funds with FHA prior to signing the project agreement for engineering services provided by negotiated A&E contract or construction of dam No. 3A. The loan funds allocated to industrial water will be repaid with interest from their regular sources of revenue starting one year after water is first used or 11 years from completion of the structure, whichever is earlier. Repayment by the city of McEwen will be completed not later than 50 years from the completion date of the structure. The interest rate will be in accordance with Sect on 8, P. L. 566, as amended.

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McEwen has initiated negotiations with FHA by filing a letter of intent to finance their share of the cost of structure site No. 3A for land rights and project administration. The loan is estimated to be $24,000. The loan repayment with interest will be from their regular sources of revenue.

Federal assistance for carrying out the works of improvement on non-Federal land, as described in this work plan, will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended. This assistance is contingent on the appropriation of funds for this purpose and the sponsoring local organization meeting their prior obligations for land rights.

Federal financial assistance for application, construction, or A&E contract will be provided under appropriate agreements executed by the sponsors and the Soil Conservation Service. The agreements to be executed are:

(1) specific operation and maintenance agreements;
(2) engineering services agreement on multiple-purpose dam No. 3A
(3) project agreement on construction or installation.

PROVISIONS FOR OPERATION AND MAINTENANCE

The land treatment measures applied on the farms will be maintained by landowners and operators at their own expense under agreement with the Humphreys and Dickson County Soil Conservation Districts. Forestry technical assistance to operate and maintain the watershed forestry measures will be provided by the going Cooperative Forest Management Program. The needed forest fire protection will be continued by the existing Cooperative Forest Fire Control Program.

Humphreys County will be responsible for adequately protecting, operating, and maintaining the single-purpose flood prevention structural works of improvement. The court's total estimated annual cost of operation and maintenance is $3,570, which includes $200 for fish management.

Operation of the vertical sliding gate will consist of opening the gate during late June or July so as to decrease the surface area of the sediment pools by 50 percent. This level will be maintained until fall. The gate will then be closed and the water level returned to its normal elevation. This drawdown for fish management will be done when the fish population needs correcting and upon the advice of a representative of the Soil Conservation Service or Tennessee Game and Fish Commission. This drawdown operation is normally estimated to be necessary once every four to five years. The vertical slide gate will be opened and closed periodically to prevent it from sticking or becoming clogged.

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The city of McEwen will be responsible for adequately protecting, operating, and maintaining multiple-purpose dam No. 3A. The total annual operation and maintenance cost is estimated to be $430. Operation of the dam may include the fluctuation of the water level and management for fish production.

The maintenance of single-purpose floodwater retarding and multiple-purpose structures will include the application of measures to prevent deterioration and the repair of damages that may occur. The cost can usually be minimized by performing maintenance when it is first needed. The maintenance of structures will include, but may not necessarily be limited to, removal of debris from principal spillways, repair of fencing, keeping adequate vegetation of the dam and emergency spillway, restoring concrete that has deteriorated, restoring protective coatings to gates, valves, and metal, and other repair of damage that has resulted from flood events or vandalism.

All floodwater retarding structures and multiple-purpose structure No. 3A will be operated and maintained in accordance with health regulations of the Tennessee Department of Public Health.

Funds for operation and maintenance of the floodwater retarding structures will be furnished by Humphreys County from its general fund.

The funds needed for operation and maintenance of multiple-purpose dam 3A will be furnished by the city of McEwen from regular sources of revenue.

The local sponsoring organizations will execute specific operation and maintenance agreements prior to obtaining Federal financial assistance or issuance of invitations to bid on construction of any structural measure.

The Service and the sponsors will make a joint inspection annually or after unusually severe floods for three years following installation of each structure. Inspection after the third year will be made annually by the sponsors and a report prepared by them with a copy to the Service representative. The Soil Conservation Service will furnish technical guidance or other information necessary for operation and maintenance.

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TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Hurricane Creek Watershed, Tennessee

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/		
		Non-Fed Land	P. L. 566 Funds	Other Funds	Total
			Non-Fed Land	Non-Fed Land	
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	3,000	0	71,400	71,400
Grassland	Acre	2,100	0	108,000	108,000
Miscellaneous Land	Acre	15	0	4,000	4,000
Technical Assistance	xxxx		28,600	14,100	42,700
SCS - Subtotal		5,115	28,600	197,500	226,100
Forest Service					
Woodland	Acre	2,460	0	39,800	39,800
Technical Assistance	xxxx		17,700	2,600	20,300
FS - Subtotal		2,460	17,700	42,400	60,100
TOTAL - LAND TREATMENT		7,575	46,300	239,900	286,200
STRUCTURAL MEASURES					
Soil Conservation Service					
Construction					
Floodwater Retarding Structures	No.	7	1,213,300	0	1,213,300
Multiple-Purpose Str.	No.	1	107,100	48,300	155,400
SCS - Subtotal			1,320,400	48,300	1,368,700
Subtotal - Construction			1,320,400	48,300	1,368,700
Engineering Services					
Soil Conservation Serv.	xxxx		172,900	12,200	185,100
Subtotal - Engineering			172,900	12,200	185,100
Project Administration					
Soil Conservation Serv.					
Construction Inspection	xxxx		30,000	1,000	31,000
Other	xxxx		85,900	18,700	104,600
Subtotal - Administration			115,900	19,700	135,600
Other Costs					
Land Rights	xxxx		0	113,500	113,500
Subtotal - Other Costs			0	113,500	113,500
TOTAL - STRUCTURAL MEASURES			1,609,200	193,700	1,802,900
TOTAL PROJECT			1,655,500	433,600	2,089,100
SUMMARY					
Total - SCS			1,637,800	391,200	2,029,000
Total - FS			17,700	42,400	60,100
TOTAL PROJECT			1,655,500	433,600	2,089,100

1/ Price base - 1971.

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TABLE 1A :- STATUS OF WATERSHED WORKS OF IMPROVEMENT
Hurricane Creek Watershed, Tennessee

Measures	Unit	Units Applied To Date	Total Estimated Cost (Dollars) 1/
LAND TREATMENT			
Conservation Cropping System	Acre	2,900	34,800
Cover and Green Manure Crops	Acre	2,900	72,500
Contour Farming	Acre	243	1,458
Contour Stripcropping	Acre	15	300
Diversions	Feet	1,950	312
Drainage Field Ditches	Feet	1,500	180
Farm Ponds	Number	30	11,350
Grassed Waterways	Acre	35	2,625
Hayland Planting	Acre	620	31,000
Pasture Planting	Acre	750	37,500
Pasture & Hayland Renovation	Acre	1,870	93,500
Tree Planting	Acre	160	2,880
Stream Channel Improvement	Feet	162,000	81,000
Hydrologic Stand Improvement	Acre	242	3,390
TOTAL - LAND TREATMENT	xxxx	xxxx	372,795

1/ Price base - 1971.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Hurricane Creek Watershed, Tennessee

(Dollars) 1/

Structure Site No. or Name	Installation Cost - P. L. 566 Funds			Installation Cost - Other Funds				TOTAL INSTALLATION COST
	Construction	Engineering	Total P. L. 566 Funds	Construction	Engineering	Land Rights	Total Other	
Floodwater Retarding Structures								
6	148,000	21,800	169,800			10,800 3/	10,800	180,600
8	129,000	18,400	147,400			10,500 3/	10,500	157,900
9	225,500	25,700	251,200			8,200 4/	8,200	259,400
10	163,700	17,800	181,500			6,800 4/ 5/	6,800	188,300
11A	258,600	29,100	287,700			23,100 3/ 6/	23,100	310,800
13	172,500	18,900	191,400			24,500 3/ 6/	24,500	215,900
14	116,000	11,800	127,800			7,600 3/ 7/	7,600	135,400
Subtotal - Floodwater Retarding Structures	1,213,300 2/	143,500	1,356,800			91,500	91,500	1,448,300
Multiple-Purpose Str. No. 3A								
Joint Cost (Dam)	107,100	29,400	136,500	35,700	9,800	22,000	67,500	204,000
Specific Cost (Water Outlet Str.)	0	0	0	12,600	2,400	0	15,000	15,000
Subtotal - Multiple-Purpose Str. No. 3A	107,100	29,400	136,500	48,300	12,200	22,000	82,500	219,000
Project Administration	xxxx	xxxx	115,900	xxxx	xxxx	xxxx	19,700	135,600
GRAND TOTAL	1,320,400	172,900	1,609,200	48,300	12,200	113,500	193,700	1,802,900

1/ Price base - 1971.

2/ Includes $11,000 for the modification of the principal spillway on single-purpose floodwater retarding dams.

3/ Includes $4,000 for removal and relocation of fixed improvements.

4/ Includes $800 for relocation or modification of utility lines.

5/ Includes $8,000 for road relocation or modification.

6/ Includes $10,000 for road relocation, $1,000 for relocation or modification of utility lines, and $2,500 for removal and relocation of fixed improvements.

7/ Includes $400 for removal and relocation of fixed improvements, and $2,000 for road relocation.

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TABLE 2A - COST-ALLOCATION AND COST-SHARING SUMMARY
Hurricane Creek Watershed, Tennessee
(Dollars) 1/

Item	COST-ALLOCATION			COST-SHARING				
	Purpose			P. L. 566 Funds		Other Funds		
	Flood Prevention	M&I Water Supply	Total	Flood Prevention	Total	Flood Prevention	M&I Water Supply	Total
Single-purpose Seven Floodwater Retarding Structures	1,448,300	0	1,448,300	1,356,800	1,356,800	91,500	0	91,500
Multiple-Purpose One Multiple-Purpose Structure for Flood Prevention and Supply	153,000	66,000	219,000	136,500	136,500	16,500	66,000	82,500
GRAND TOTAL	1,601,300	66,000	1,667,300	1,493,300	1,493,300	108,000	66,000	174,000

1/ Price base 1971.

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TABLE 3 - STRUCTURAL DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Hurricane Creek Watershed, Tennessee

ITEM	UNIT	Structure Numbers				
		3A	6	8	9	10
Class of Structure		b	b	b	a	a
Drainage Area	Sq.Mi.	1.25	2.49	1.89	2.63	1.72
Curve No. (1-day)(AMC II)		70	71	70	71	70
Tc	Hrs.	0.81	1.40	1.56	1.90	1.31
Elevation Top of Dam	Ft.	696.0	708.5	689.5	632.0	621.0
Elev. Crest Emer. Spwy.	Ft.	692.5	704.0	685.5	626.0	615.0
Elev. Crest High Stage Inlet	Ft.	689.5	699.5	682.5	622.5	612.5
Elev. Crest Low Stage Inlet	Ft.	681.0	689.3	674.6	610.7	600.4
Max. Height of Dam	Ft.	41.0	43.0	35.0	38.0	37.0
Volume of Fill	Cu.Yds.	135,200	170,000	106,600	165,350	103,470
Total Capacity	Ac.Ft.	480	715	525	653	392
Sediment Submerged (100-yr.)	Ac.Ft.	83	176	136	113	78
Sediment Aerated	Ac.Ft.	15	15	11	9	6
Beneficial Use (Industrial Water Supply)	Ac.Ft.	120	-	-	-	-
Retarding	Ac.Ft.	262	524	378	531	308
Between High & Low Stages	Ac.Ft.	174	326	240	358	228
Surface Area						
Sediment Pool	Acres	11	22	21	20	12
Beneficial Use Pool (Industrial Water Supply)	Acres	18	-	-	-	-
Retarding Pool	Acres	32	49	52	51	32
Principal Spillway						
Rainfall Volume (areal)(1-day)	In.	6.50	6.50	6.50	5.85	5.85
Rainfall Volume (areal)(10-day)	In.	11.60	11.60	11.60	10.50	10.50
Runoff Volume (10-day)	In.	5.01	5.16	5.01	4.33	4.19
Capacity of Low Stage (Max.)	cfs	12	45	23	17	11
Capacity of High Stage (Max.)	cfs	116	177	163	108	107
Freq. Operation - Emer. Spwy.	% Chance	1.5	1.2	1.4	1.3	2.3
Size of Conduit	Dim.	30	36	36	30	30
Emergency Spillway						
Rainfall Volume (ESH)(areal)	In.	7.84	7.84	7.84	7.84	7.84
Runoff Volume (ESH)	In.	4.32	4.44	4.32	4.44	4.32
Type		Veg	Veg	Veg	Veg	Veg
Bottom Width	Ft.	100	100	85	83	63
Velocity of Flow (V_e) 2/	Ft./Sec.	-1/	-1/	-1/	7.0	7.2
Slope of Exit Channel	Ft./Ft.	0.025	0.021	0.024	0.020	0.020
Maximum Water Surf. Elev.2/	Ft.	-	-	-	628.3	617.5
Freeboard						
Rainfall Volume (FH)(areal)	In.	14.52	14.52	14.52	14.56	14.56
Runoff Volume (FH)	In.	10.40	10.55	10.40	10.59	10.44
Maximum Water Surf. Elev.	Ft.	696.0	708.5	689.5	632.0	621.0
Capacity Equivalents						
Sediment Volume	In.	1.47	1.43	1.45	0.87	0.92
Retarding Volume	In.	3.93	3.94	3.75	3.79	3.36

(Continued)

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TABLE 3 - STRUCTURAL DATA (Cont.)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Hurricane Creek Watershed, Tennessee

ITEM	UNIT	Structure Numbers 11A	13	14	Total
Class of Structure		a	a	a	
Drainage Area	Sq.Mi.	5.64	2.52	1.55	19.69
Curve No. (1-day)(AMC II)		70	71	70	-
Tc	Hrs.	2.47	1.21	1.46	-
Elevation Top of Dam	Ft.	638.0	546.0	470.0	-
Elev. Crest Emer. Spwy.	Ft.	631.0	540.0	465.0	-
Elev. Crest High Stage Inlet	Ft.	626.5	536.0	462.5	-
Elev. Crest Low Stage Inlet	Ft.	613.6	524.5	453.5	-
Max. Height of Dam	Ft.	43.0	35.0	29.0	-
Volume of Fill	Cu.Yds.	160,290	118,960	73,210	1,033,080
Total Capacity	Ac.Ft.	1,393	621	349	5,128
Sediment Submerged (100-yr.)	Ac.Ft.	204	92	71	953
Sediment Aerated	Ac.Ft.	17	7	6	86
Beneficial Use (Industrial Water Supply)	Ac.Ft.	-	-	-	120
Retarding	Ac.Ft.	1,172	522	272	3,969
Between High & Low Stages	Ac.Ft.	744	339	202	2,611
Surface Area					
Sediment Pool	Acres	36	19	15	156
Beneficial Use Pool (Industrial Water Supply)	Acres	-	-	-	18
Retarding Pool	Acres	106	50	30	402
Principal Spillway					
Rainfall Volume (areal)(1-day)	In.	5.85	5.85	5.85	-
Rainfall Volume (areal)(10-day)	In.	10.50	10.50	10.50	-
Runoff Volume (10-day)	In.	4.19	4.33	4.19	-
Capacity of Low Stage (Max.)	cfs	34	16	20	-
Capacity of High Stage (Max.)	cfs	170	106	102	
Frequency Operation - Emer. Spwy.	% Chance	1.2	1.2	2.4	
Size of Conduit	Dim.	36	30	30	
Emergency Spillway					
Rainfall Volume (ESH)(areal)	In.	7.84	7.84	7.84	
Runoff Volume (ESH)	In.	4.32	4.44	4.32	
Type		Rock	Rock	Veg	
Bottom Width	Ft.	100	70	74	
Velocity of Flow (V_e) 2/	Ft./Sec.	6.5	6.8	5.4	
Slope of Exit Channel	Ft./Ft.	0.022	0.021	0.025	
Max. Water Surface Elev. 2/	Ft.	633.2	542.2	466.5	
Freeboard					
Rainfall Volume (FH)(areal)	In.	14.56	14.60	14.56	
Runoff Volume (FH)	In.	10.44	10.63	10.44	
Max. Water Surface Elev.	Ft.	638.0	546.0	470.0	
Capacity Equivalents					
Sediment Volume	In.	0.75	0.74	0.93	
Retarding Volume	In.	3.90	3.88	3.29	

1/ Slope based on 25% of discharge from freeboard hydrograph.
2/ Little or no flow except as shown.

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TABLE 4 - ANNUAL COST
Hurricane Creek Watershed, Tennessee
(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total Annual Cost
Floodwater Retarding Structures, Multiple-Purpose Structure No. 3A, and Mitigating Measures	86,016	4,000	90,016
Project Administration	6,996	xxxx	6,996
GRAND TOTAL	93,012	4,000	97,012

1/ The floodwater retarding structures amortized for 100 years at 5-1/8 percent interest (0.05159), using 1971 price base.
2/ Price base - adjusted normalized.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Hurricane Creek Watershed, Tennessee

(Dollars) 1/

Item	ESTIMATED AVERAGE ANNUAL DAMAGES		Damage Reduction Benefits
	Without Project	With Project	
FLOODWATER			
Crops and Pasture	50,258	11,065	39,193
Other Agricultural	6,671	1,146	5,525
Non-Agricultural			
Road and Bridge	23,640	1,682	21,958
Subtotal - Floodwater	80,569	13,893	66,676
SEDIMENT			
Overbank Deposition	5,568	1,240	4,328
EROSION			
Flood Plain Scour	8,994	1,925	7,069
INDIRECT	15,942	1,931	14,011
GRAND TOTAL	111,073	18,989	92,084

1/ Price base - Adjusted Normalized.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Hurricane Creek Watershed, Tennessee
(Dollars)

Evaluation Unit	ESTIMATED AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost	Benefit-Cost Ratio
	Flood Damage Reduction 2/	More Intensive Land Use	Industrial Water Supply	Secondary	Total		
Floodwater Retarding Structures and Multiple-Purpose Structure No. 3A	91,003	37,310	7,500	13,532	149,345	90,016	1.7:1.0
Project Administration	xxxx	xxxx	xxxx	xxxx	xxxx	6,996	xxxx
GRAND TOTAL	91,003	37,310	7,500	13,532	149,345	97,012	1.5:1.0

1/ Price base - Adjusted Normalized. See table 4 for costs.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $1,081 annually.

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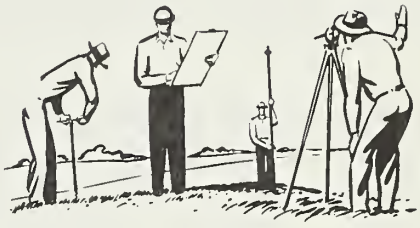
INVESTIGATION AND ANALYSES

Engineering Surveys

The engineering field surveys on the Hurricane Creek Watershed consisted of establishing 37 miles of vertical control, surveying 33 valley cross-sections, and 150 channel cross-sections. Mean sea level was used as the datum for elevations. All vertical control was established in feet with an elevation tolerance of 0.07 times the square root of the length of circuit (m) in miles.



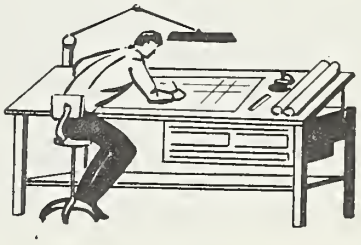
The valley and channel cross-sections were chained and elevations recorded to the nearest 0.1 foot. These sections were located on aerial photographs and distances between sections were scaled from these photographs. Elevations of bridges, road crossings, culverts, and other control points were established.

Topographic maps of the floodwater retarding structures were prepared on photographic prints as base maps. Contours were run at 4-foot intervals by level and were located on the base map using a telescopic alidade and plane table.

The field survey data, profiles and cross-sections were plotted showing the present ditches and average ground elevations to give an adequate picture of valley shape for flood-routing and design computations. The topographic maps of the floodwater retarding structure sites were used to develop stage-storage and stage-area curves for design.

Design

Preliminary designs for eight proposed floodwater retarding structures were based on the design criteria established in Engineering Memo SCS-27 (Revised), dated March 19, 1965. Hazard classification for each structure was determined by field review of structure locations. All structures except No. 3A were designed as single-purpose floodwater retarding structures. Structure No. 3A was designed for floodwater detention and water supply for industrial use.



Provisions were made for storing the expected 100-year sediment accumulation in each of the structures. Sediment distribution was determined using the procedure outlined in TR-12 (Revised), dated January 1968.

Detention volume requirements for all structures were determined by the short-cut, mass-inflow method described in Tennessee Engineering Memo TN-11 dated June 1, 1966. All structures were designed to have two-stage

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principal spillways. The storage between the high and low stages for these structures is one-half of the 25-year runoff as determined by Engineering Memo TN-11. Flood detention volumes, as determined using the above mentioned procedures, were compared with the minimum flood storage volumes as determined by use of methods based on Chapter 21 in Section 4, Hydrology, Part I - Watershed Planning, of the National Engineering Handbook and were found to exceed these minimums.

Emergency spillways were designed using the storage-discharge relationship outlined in Technical Release No. 2 for the design and freeboard hydrographs of each structure as determined by Engineering Memo SCS-27. Each spillway was proportioned using SCS Drawing No. 2-L-9200-2, titled "Earth Spillways: Hydraulic Relationships". Eight floodwater retarding structures, including multiple-purpose structure No. 3A, are included in the work plan.

A consultant engineering firm employed by the city of McEwen developed the future industrial water supply needs. The total required storage to meet this future need is about 120 acre-feet. A reservoir operation analysis prepared by the Soil Conservation Service compared favorably with the consultant's recommendations.

Hydrologic

Precipitation data were obtained from the U. S. Weather Bureau publication, "Climatological Data and Hourly Precipitation Data". The historical series was developed from 20 years of records for the non-recording gage at McEwen, Tennessee. The hourly storm distribution was obtained from an average of the distribution of the U. S. Weather Bureau recording precipitation gages at Johnsonville Steam Plant and Dickson, Tennessee. The maximum storm of the evaluation series began around 2:00 a.m., January 29, 1956, and continued for approximately 24 hours. There was a total of 6.60 inches of rainfall which produced an estimated 3.29 inches of runoff.

Using data from field surveys, stage-discharge relationships at 33 valley cross-sections were calculated using Manning's Formula. In developing the maximum flood plain inundated, base hydrographs were flood-routed through 10 hydraulic reaches by using "The Improved Coefficient Method", and flood-routed peaks were compared with known flood marks. Stage-area inundation tables were developed by one-foot increments based on flood-routed hydrographs. Peak rates of discharge at intermediate cross-sections were obtained from a logarithmic plotting of routed peaks versus drainage area.

The frequency method of analysis was used. Peak discharges for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year floods were obtained from logarithmic plottings. The peak discharge curve was based on the plottings of the flood peaks of the January 29-30, 1956 and annual flood for the various frequency floods.

Geologic

All available geologic maps and reports were reviewed for the purpose of noting geologic relationships. The composition of sedimentary layers,

their lateral variations, and any other geologic conditions which may affect the structural works were considered.

Prelinimary investigations at the proposed floodwater retarding structure sites were made with a refraction seismograph plus inspection of outcrops and road cuts in the area. This preliminary investigations with the seismograph have inconclusive results so special authorization to do a limited amount of drilling with power equipment was obtained.

A limited number of test holes were drilled on five proposed sites with either a Damco 1250, Failing 1500, or Mobile B-40 drill rig using fishtail bits, casing bits, diamond core barrel, and helical augers.

Alternate Site No. 5A, located about the L & N Railroad on Hurricane Creek, was drilled but is not included in the work plan. Conditions at the site indicate 15 to 25 feet of permeable, gravelly alluvium over residual, cherty clay from the weathering of St. Louis Limestone. Eight test holes from 65 to 100 feet deep were drilled. The investigation indicates that the placement of positive cutoff at similar dam sites may be feasible to prevent potential piping beneath the structures.

Structures Nos. 3A, 6, and 8 are similar to alternate Site No. 5A; however, no subsurface investigations were made. Residual cherty clay material of the St. Louis Limestone is exposed in the stream channel on Site No. 3A. This indicates that a cutoff could be made at relatively shallow depths, although water-holding ability of Site No. 3A will be confirmed by engineers representing the city of McEwen.

Structures No. 10 has 10 to 60 feet of alluvium and residual material over limestone bedrock. Since cavernous areas were located near each abutment, grouting of caverns will be necessary to insure stability of the structure. The need for foundation drains is also anticipated.

Structure No. 11A has 10 to 20 feet of cherty clay alluvium over limestone bedrock. The top four to eight feet of the limestone is weathered. A joint or old solution channel about 50 feet deep filled with alluvium was found in the middle of the flood plain. Treatment of the weathered rock and joint or solution channel will be necessary during construction. Installation of foundation drains along with excavation and/or grouting of highly weathered foundation rock and cavernous areas may be needed.

Structure No. 9 was not drilled but it will be very similar to structures 10 and 11A.

Structures 13 and 14 are quite similar. The foundation consists of permeable, gravelly alluvium over limestone bedrock. Both structures have deep joints or old solution channels filled with the gravelly alluvium in their foundations. The thickness of the alluvium varies from 8 to 80 feet on Sites 13 and 8 to 60 feet on Site 14. These joints or channels are areas of potential differential consolidation in the structure. The amount of possible consolidation is related to the density of this material. The drilling equipment used in drilling these test holes was inadequate to

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obtain samples to make a determination of the density. The density of this material being the key to the feasibility of these two sites meant that further investigations were necessary. Seven additional test holes were drilled, cased with plastic pipe and logged with a gamma ray density probe. The interpretation of this logging indicated a fairly dense material in which consolidation should not be a critical problem. A positive cutoff in this deep, dense, permeable material is not feasible. Foundation drains will be needed to control seepage and insure against the possibility of piping.

Many of the solution channels in the foundation rock at the dam sites may be filled or partially filled with unstable residual materials. Water pressures created by permanent or temporary storage in the reservoir areas may force these unstable materials from the voids in the foundation rock. Flow of water through these solution channels may produce excessive seepage and subterranian erosion which could cause overlying foundation rock to collapse. Uncontrolled seepage and deterioration of the supporting bedrock beneath a dam would greatly endanger the stability of the structure.

Subsurface pressure grouting of cavernous foundation rock will be accomplished only as needed to insure stability of the structures and will not be used for the sole purpose of improving the water-holding ability of the sites.

Form SCS-375, Preliminary Geologic Investigation of Dam Sites, was compiled for each of the proposed structures. On these forms, and in a narrative geologic report of Hurricane Creek Watershed, the geologic conditions peculiar to the area were discussed and geologic conditions and investigative methods that should be given consideration during the detailed site investigation were outlined.

Sedimentation

The calculations of gross erosion were made by use of Musgrave's Equation. Land use and cover, percent slope, length of slope, and maximum two-year, 30-minute rainfall are factors used in these calculations to determine gross erosion under present conditions and future conditions with the project installed.

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Detailed land use measurements were made of the area above each proposed floodwater retarding structure. These data were used in the procedure as outlined in Technical Release No. 12, Soil Conservation Service, Engineering Division, September 1959, to determine the required volume of sediment pools.

The area of the flood plain land affected by sediment and scour damage were determined by mapping the flood plain. Data gathered were processed and expanded for the reaches involved and summaries were prepared showing location and extent of these damages. These form the basis for calculations by the economist.

Land Use and Treatment

Soil surveys of the Hurricane Creek Watershed were made from 1952 to the present by soil scientists of the Soil Conservation Service. This mapping showed soil type, slope, and degree of erosion.

Present open land use of the uplands was determined by use of aerial photographs and by consultation with the local district conservationists. Present land use of the flood plain was determined by field mapping on aerial photographs.

The amount of land treatment now on the ground was determined from farm plans, plus field checks. The land treatment measures to be installed during the 5-year installation period were determined from the total needs of the watershed.

Fish and Wildlife

A study and analysis of the Hurricane Creek Watershed was made by biologists of the Tennessee Game and Fish Commission, U. S. Fish and Wildlife Service, and Soil Conservation Service, working together and individually. The analysis included physical characteristics of the stream and watershed as related to fish and wildlife resources, relative extent of fish and wildlife species and population, and relative hunting and fishing pressure and success.

The extent and composition of the fish and wildlife resources in the Hurricane Creek Watershed was determined by the Biology Work Group through interviews with the local Tennessee Game and Fish Commission Conservation Officers, and through observations and comparisons of this watershed with similar watersheds in Middle Tennessee where intensive studies have been made. The structural measures proposed for flood prevention and sediment storage were evaluated by the Work Group for the effect on the fish and wildlife resources.

Forestry

A field survey determined the upland forest conditions. Systematic samples showed ground cover, forest and hydrologic conditions, treatment needs, and measures. This survey, supporting data, information from other agencies and forestry officials determined the amount of remedial measures. The installation period limits the amount of work recommended. These measures

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include only those which contribute directly to flood reduction and soil stabilization.

Economic

The methods used in making economic investigations and analyses followed those approved by the Soil Conservation Service in benefit-cost evaluations on land and water resource projects. The methods used are in accordance with instructions in the National Economic Guide.

Basic data were obtained from local farmers and residents, agricultural workers, State and County Highway officials, experiment stations, and agricultural publications. Basic information was obtained by interview with landowners and operators having flood plain land and consisted of the following: present land use and yields; normal flood-free land use and yields; anticipated land use and yields with various degrees of flood protection; information concerning the normal sequence of the various farming operations; and estimates of the percent damage to the various crops and pasture by depths of inundation by months or specific flood events.

Adjusted normalized prices were used as a basic for benefit computations, cost of production and cost of operation and maintenance. These adjusted normalized prices were developed from standards and criteria developed by the Interdepartmental Staff Committee of the Water Resources Council, dated April 1966.

The IBM 1130 computer was used to evaluate probable damages and benefits by use of the "Frequency Method". A comparison of evaluated damages without and with project installed was used to determine flood damage reduction benefits from input physical and economic flood characteristics and their frequency of occurrence. Output data provided benefits from alternative programs to use in project formulation and justification.

Local secondary benefits were evaluated and used in project justification. Secondary benefits from a national viewpoint were not used in the evaluation or justification of this proposed work plan.

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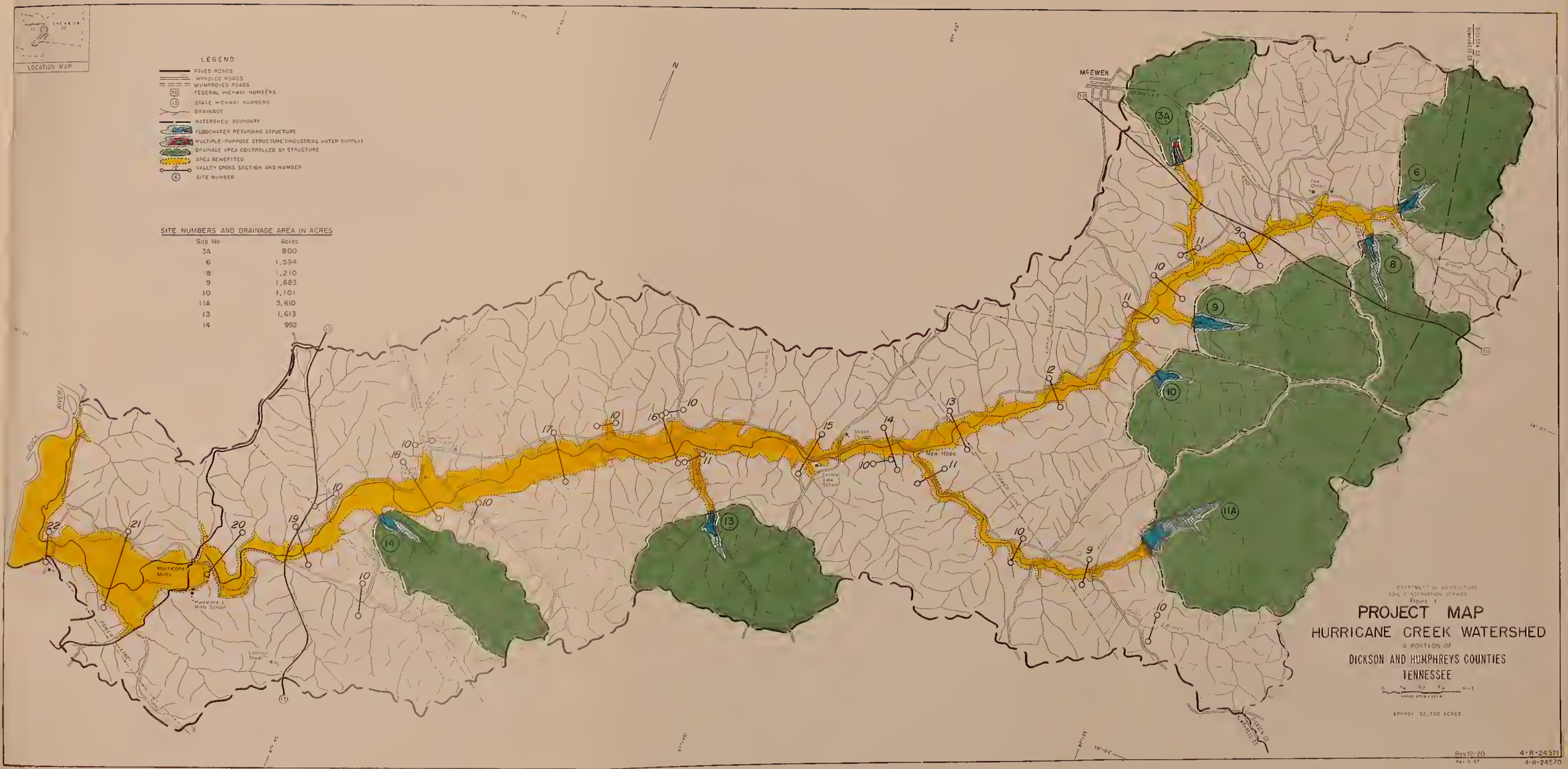
LOCATION MAP
LEGEND
PAVED ROADS
IMPROVED ROADS
UNIMPROVED ROADS
FEDERAL HIGHWAY NUMBERS
STATE HIGHWAY NUMBERS
DRAINAGE
WATERSHED BOUNDARY
FLOODWATER RETARDING STRUCTURE
MULTIPLE-PURPOSE STRUCTURE (INDUSTRIAL WATER SUPPLY)
DRAINAGE AREA CONTROLLED BY STRUCTURE
AREA BENEFITED
VALLEY CROSS SECTION AND NUMBER
SITE NUMBER
SITE NUMBERS AND DRAINAGE AREA IN ACRES
Site No Acres
3A 800
6 1,594
8 1,210
9 1,683
10 1,101
11A 3,610
13 1,613
14 992
McEWEN
Shiloh Church
New Hope
Central View School
Hurricane Mills
Hurricane Mills School
Lookout Tower
Buck River
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Figure 1
PROJECT MAP
HURRICANE CREEK WATERSHED
A PORTION OF
DICKSON AND HUMPHREYS COUNTIES
TENNESSEE
APPROX 52,780 ACRES
Rev 12-70
Rev 9-67
4-R-24571
4-R-24570

A 1971 price base was used as the basis for installation costs. The costs of land rights were developed in meetings with the sponsors. A detailed investigation of land rights needed to install the eight dams included in this plan revealed that no displacement of person, business or farm operations would be required as described in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The unit costs of road and bridge relocation, modification or alteration were developed in meetings with County Highway officials.

Joint costs for construction and engineering services of multiple-purpose structure No. 3A were allocated by the Use of Facilities Method. This method provides that costs be allocated by the percent of storage for each purpose as a ratio of the total storage. The specific costs of land to be acquired to fee simple title were allocated in industrial water on the basis of surface acreage needed. Flowage easements were allocated to flood prevention, and installation cost of water outlet structure to industrial water.

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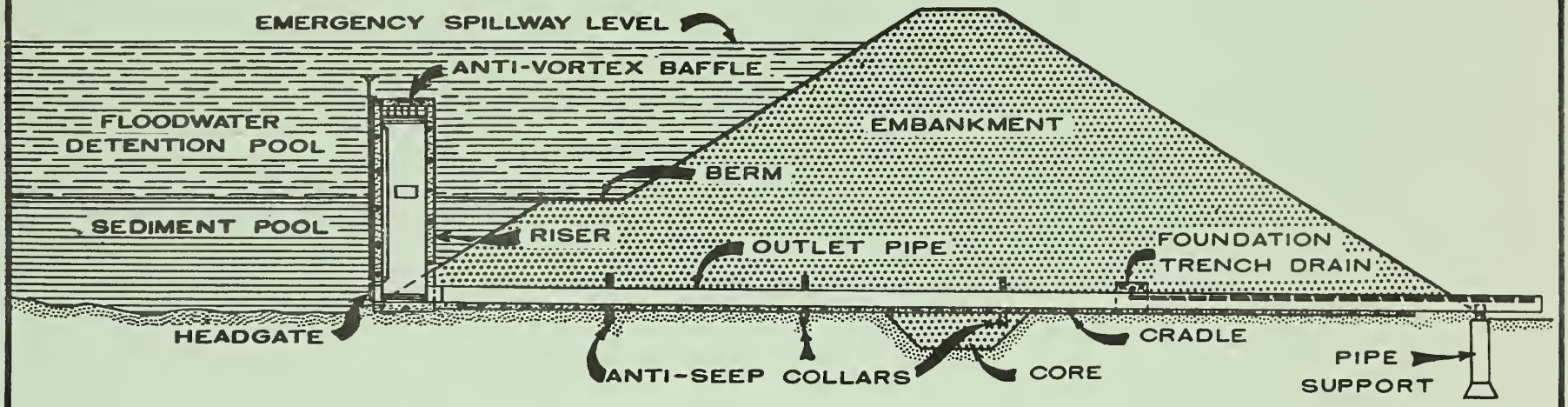

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

(TWO STAGE DROP INLET)

USDA SCS-FORT WORTH, TEX. 1967